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Application of Combustion Modifications to Industrial Combustion Equipment (Data Supplement A)

KVB Engineering, Inc, Tustin, CA

Prepared for

Industrial Environmental Research Lab, Research Triangle Park, NC

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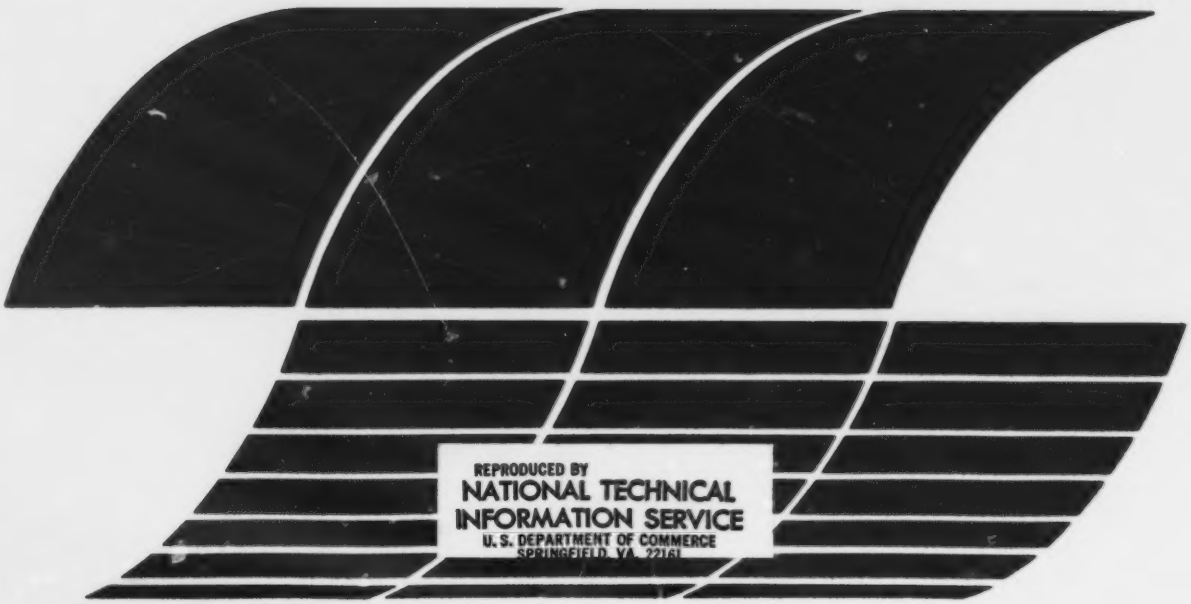
Interagency Energy/Environment R&D Program Report



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16. ABSTRACT The supplement provides raw data from a study of the effects of combustion modifications on air pollutant emissions from a variety of industrial combustion equipment. Tested were 22 units, including refinery process heaters; clay and cement kilns; steel and aluminum furnaces; boilers burning black liquor, woodbark, and CO gas; internal combustion engines; and gas turbine combined cycles. Process variables, fuel types, excess air reduction, burner adjustments, and staged combustion were evaluated primarily for their effect on NOx emissions. Emissions of NOx, SOx, CO, and HC were measured on all units. Emissions of particulate mass and size, trace species, and organics were measured on selected units. This data supplement is intended for researchers who wish to perform their own detailed calculations.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group	
Air Pollution	Chemical Analysis	Air Pollution Control	13B	07D
Combustion	Industrial Processes	Stationary Sources	21B	13H
Boilers	Gas Turbine Engines	Combustion Modification	13A	21E
Furnaces	Reciprocating Engines	Particulate		
Nitrogen Oxides		Excess Air	07B	21G
Dust	Organic Compounds	Staged Combustion	11G	07C
Fossil Fuels	Inorganic Compounds		21D	
Particle Size			14B	

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Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

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Limitations On Application Of Data Reported

The data cited in this report are test results for measured pollutant emissions from a wide variety of industrial combustion equipment types. Only a limited number of each equipment type could be tested. Therefore, these emission levels are not suitable for use in estimating mean emissions from industrial combustion equipment classes and should not be used alone in compiling area-wide emission inventories. Also, they are not suitable for predicting emissions from any one process or as regulatory limits or emission standards. Use of these emissions as emission standards may place a large proportion of the industrial combustion device population in noncompliance. The data can however be of use in supplementing other data used for these purposes. The purpose of this test program was to investigate the feasibility of combustion modifications for emissions control, not to develop a comprehensive emissions data base.

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FOREWORD

The purpose of this Data Supplement, which is presented in two volumes, is to document data in greater detail than was practical in the final report for this contract. It is intended to provide the necessary details to other researchers who are interested in performing their own analysis.

Readers are referred to the contract final report for information as to objectives, selection of units, measurement procedures, interpretations and conclusions.[1]

All data presented for gaseous emission concentrations of NO, NO_x, CO, HC, SO_2 and SO_3 are expressed in parts per million by volume (ppm) on a dry basis corrected to 3 percent O_2 by volume (dry) in the flue gas.

The data are arranged in this volume by Location Number for Locations 1 through 16. A location is defined as one company or plant in which one or more units were tested. Each unit tested at a location is identified by a unit number. The contract final report refers to the test number when data are discussed. The test number is of the form xx/yy-zz, where xx = location number, yy = unit number, and zz = test number on that unit. For sites where only one unit was tested the /yy unit number is deleted.

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[1]Hunter, S. C., et al., "Application of Combustion Modifications to Industrial Combustion Equipment," EPA 600/7-79-105a, January 1979.

For each unit tested, the data supplement contains the following information:

1. Equipment Design Data

   Design data tabulations include: unit description, installation date, process capacity, burner description, fuels burned, combustion air temperature and other data pertinent to each unit.

2. Mobile Laboratory Data (Emission Measurements)

   Emission measurements tabulated for each test include test number, test load, combustion conditions (excess O_2, CO_2), gaseous emissions (NO_x, NO, CO, HC, SO_x and SO_2 all at 3% O_2, dry), total particulates and solid (filterable) particulates, thermal efficiency, Bacharach smoke spot number, and plume opacity.

3. Operating Data

   Data pertinent to the process is tabulated for each test.

4. Fuel Analyses

   Analyses of test fuels are included as reported for fuel samples collected during tests.

5. Particulates Measurement Data

   Particulates data includes measurements of total and solid particulates by EPA Method 5.

6. Cascade Impactor Data

   Impactor data include impactor flow conditions, stage collection weights, and calculated aerodynamic particle size for each stage.

   One impactor used was a Brink Model B (BMS-11) with the following stage dimensions:

Jet No.	Jet Dia., in.	Spacing of Jet Opening, in.
1	0.249	0.747
2	0.1775	0.533
3	0.1396	0.419
4	0.0946	0.282
5	0.0731	0.220

The second impactor used was an Anderson 2000 Mark III with the following stage dimensions:

Stage No.	Jet Diameter, cm
1	0.1638
2	0.1253
3	0.0948
4	0.0759
5	0.0567
6	0.0359
7	0.0261
8	0.0251

7. Opacity Data

Plume opacity was observed by EPA Method 9.

8. Stack Traverse Data

Stack traverses are made with a pitot tube.

9. Trace Species and Organics Sample Data

Sample acquisition logs and results of sample analyses by atomic absorption, spark source mass spectrometry, wet chemistry, gas chromatography, and gas chromatography/mass spectrometry are included.

Dash marks entered on the data forms indicate that data were not available.

INSTRUMENTATION

The emission measurements were made with instrumentation contained in a 2.5 by 9 meter (8 by 27 ft) laboratory trailer. The gaseous emission measurements were made with analyzers located in the measurement console in the trailer. The particulate concentration, particulate size, sulfur oxides, and trace species concentration measurements were made with instrumentation prepared in the wet chemistry area of the laboratory and taken to the sample port. The weighing and titration were done in or near the laboratory.

The emission measurement instrumentation used for the program was that shown in Table 1. The operation of the instrumentation is discussed in detail in the contract final report.

TABLE 1. EMISSION MEASUREMENT INSTRUMENTATION

Emission	Symbol	Measurement Method	Equipment Mfgr & Model
Nitric oxide	NO	Chemiluminescent*	Thermo Electron, 10A
Oxides of nitrogen	NO_x	Chemiluminescent*	Thermo Electron, 10A
Carbon monoxide	CO	Spectrometer*	Beckman, 864
Carbon dioxide	CO_2	Spectrometer*	Beckman, 865
Oxygen	O_2	Polarographic*	Teledyne, 326A
Hydrocarbons	HC	Flame ionization*	Beckman, 402
Sulfur dioxide	SO_2	Photometric*	Dupont 400
Sulfur dioxide and trioxide	SO_2 SO_3	Absorption/ titration	KVB Equipment Co.
Total particulate matter	PM	EPA Std. Method 5	Joy Mfg. Co.
Particulate size	--	Cascade impactor	Monsanto-Brink, B(BMS-11) Anderson 2000, Mark III
Smoke spot	--	Reflection	Research Appliance Co.
Opacity	--	EPA Std. Method 9	--
Trace Species and Organics	TS&O	EPA SASS Train	Acurex/Aerotherm SASS

*Precision, $\pm$ 1% of Full Scale

GLOSSARY OF SYMBOLS USED ON DATA FORMS

Burner Type

Air	Air Atomizer
ChGrt	Chain Grate
Pulv.	Pulverizer
Ring	Natural Gas Ring
SpStk	Spreader Stoker
Spud	Natural Gas Gun
Steam	Steam Atomizer

Test Fuel

Coal	Coal
NG	Natural Gas
Ref.Gas	Refinery Gas
NG/#6	Mixture, NG and #6
#2	No. 2 Grade Fuel Oil
#5	No. 5 Grade Fuel Oil
#6	No. 6 Grade Fuel Oil
PS300	Pacific Standard Fuel Oil No. 300

Test Type

Air Reg	Air Register Adjustment
Atom Press	Burner Atomizing Pressure Adjustment
BOOS	Burners Out Of Service
Base	Baseline
BrTune	Boiler Tuneup
CombCyc	Combined Cycle
Damper	Air Damper Adjustment
HiAir	High Excess Air
HiLoad	High Load
LowAir	Low Excess Air
LowLoad	Low Load
LowNOx	Low NOx Condition
NrmlAir	Normal Excess Air
OFA	Overfire Air
SCA	Staged Combustion Air
SnglCyc	Single Cycle
SteamInjec	Steam Injection
VPH	Variable Combustion Air Temperature
Viscosity	Fuel Oil Viscosity

CONVERSION FACTORS

SI Units to Metric or English Units

To Obtain	From	Multiply By
g/Mcal	ng/J	0.004186
10^6 Btu	GJ	0.948
Btu	gm cal	3.9685×10^{-3}
lb/10^6 Btu	ng/J	0.00233
ft	m	3.281
in.	cm	0.3937
ft^2	m^2	10.764
ft^3	m^3	35.314
lb	kg	2.205
Fahrenheit	Celsius	$t_F = 9/5(t_c) + 32$
Fahrenheit	Kelvin	$t_F = 1.8t_K - 460$
psig	Pa	$P_{psig} = (P_{pa})(1.450 \times 10^{-4}) - 14.7$
psia	Pa	$P_{psia} = (P_{pa})(1.450 \times 10^{-4})$
iwg (39.2 °F)	Pa	$P_{iwg} = (P_{pa})(4.014 \times 10^{-3})$
10^6 Btu/hr	MW	3.413
GJ/hr	MW	3.60

To Obtain ppm at 3% O_2 of	Multiply* Concentration in ng/J by
Natural Gas Fuel	
CO	3.23
HC	5.65
NO or NO_x	1.96
SO_2 or SO_x	1.41
Oil Fuel	
CO	2.93
HC	5.13
NO or NO_x	1.78
SO_2 or SO_x	1.28
Coal Fuel	
CO	2.69
HC	4.69
NO or NO_x	1.64
SO_2 or SO_x	1.18

*These conversions depend on fuel composition.
The values given are for typical fuels.

English and Metric Units to SI Units

To Obtain	From	Multiply By
ng/J	$lb/10^6$ Btu	430
ng/J	g/Mcal	239
GJ	10^6 Btu	1.055
m	ft	0.3048
cm	in.	2.54
m^2	ft^2	0.0929
m^3	ft^3	0.02832
kg	lb	0.4536
Celsius	Fahrenheit	$t_c = 5/9\ (t_F - 32)$
Kelvin	Fahrenheit	$t_K = 5/9\ (t_F - 32) + 273$
Pa	psig	$P_{pa} = (P_{psig} + 14.7)(6.895 \times 10^3)$
Pa	psia	$P_{pa} = (P_{psia})(6.895 \times 10^3)$
Pa	iwg (39.2 °F)	$P_{pa} = (P_{iwg})(249.1)$
MW	10^6 Btu/hr	0.293
MW	GJ/hr	0.278

To Obtain ng/J of	Multiply* Concentration in ppm @ 3% O_2 by
Natural Gas Fuel	
CO	0.310
HC	0.177
NO or NO_x (as NO_2)	0.510
SO_2 or SO_x	0.709
Oil Fuel	
CO	0.341
HC	0.195
NO or NO_x (as NO_2)	0.561
SO_2 or SO_x	0.780
Coal Fuel	
CO	0.372
HC	0.213
NO or NO_x (as NO_2)	0.611
SO_2 or SO_x	0.850

*These conversions depend on fuel composition. The values given are for typical fuels.

CERAMIC TUNNEL KILN DESIGN DATA

Location No. 1 Unit No. 1

Unit Description THE KILN HAS A CAPACITY FOR 46 CARS, EACH TEN FEET LONG. IT CONSISTS OF A HEATING ZONE, A MAIN FURNACE ZONE, AND A COOLING ZONE. THE COMBUSTION AIR IS SUPPLIED BY FORCED DRAFT FANS.

Installation Date	1954
Process Capacity	600 THERMS/WEEK
Burner Description	NORTH AMERICAN 223-4
Test Fuel	NATURAL GAS
Fuel Temp. at Burner (°F)	AMBIENT
Primary Air Temp. (°F)	AMBIENT

Comments:

Test No. _____ to _____

KVB, INC.

Test Engr. WAC

MOBILE LABORATORY DATA

Test Number 1-1 Date APRIL 6, 1976

Unit Number TUNNEL KILN NO. 2 Owner _____

Fuel L.A. NATURAL GAS Location _____

Capacity (k#/hr) _____ Identification _____

Furnace Type TUNNEL KILN Burner Type NO. AMERICAN 223-4

1. Test Number	1-1		1-2		1-3		1-4							
2. Load (k#/hr) or Btu/hr														
3. Flue Diameter (ft)	6'x6'		6'x6'		6'x6'		6'x6'							
4. Probe Position	CENTER		CENTER		CENTER		CENTER							
5. Process Rate	16 CARS/24 hr.		16 CARS/24											
6.			10:00		11:30		1345							
7. Water Content (% vol.)														
8. Oxygen (%)	17%		16.7%		17.0%		17.0%							
9. NOx(hot line) reading/@3% O_2(ppm)	21	94	13	54	20	90	16	72						
10. NO(hot line) reading/@3% O_2(ppm)	15	68	11	46	19	86	15	68						
11. NO_2(hot line) reading/@3% O_2(ppm)	6	26	2	8	1	4	1	4						
12. ~~NOx dry @ 3% O_2 (hot line) ppm~~														
13. ~~NO dry @ 3% O_2 (hot line) (ppm)~~														
14. ~~NO_2 dry @ 3% O_2 (hot line) (ppm)~~														
15. Carbon Dioxide (%)	3.6		4.2		3.4		3.4							
16. Carbon Monoxide (ppm) uncor./cor.	55	248	75	314	30	135	60	270						
17. Hydrocarbon (ppm)	19		15		18		17							
18. Sulfur Trioxide (ppm)	-		-		-									
19. Sulfur Dioxide (ppm)	-		-		-									
10. Total Particulate (g/Mcal)	-		-		-									
11. Total Particulate (lb/Mbtu)	-		-		-									
12. Smoke Number	-		-		-									
13. NO(cold line) reading/dry @3% (ppm)	20	90	12	50	17	77	16	72						
14.														
15. Atmos. Temp. (F°/C°)	70°F		67		62.5		66							
16. Dew Point Temp. (F°/C°)	60°F		59		58		59							
17. Atmos. Pressure(in.Hg)	29.90		30.00		29.94		29.90							
	56%		63%		77%		67%							
	4/6/76		4/7/76		4/8/76		4/8/76							

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OPERATING DATA

Tunnel Kiln No. 2

Data taken by: H. BUENING

Fuel L.A. NATURAL GAS

Test No.	1-1	1-2	1-3	1-4		
Time	1537		11:40	14:17		
Date	4-6-76	4-7-76	4-8-76	4-8-76		
Process rate	16 CARS/24 hrs.	16 CARS/24 hrs.	16 CARS/24 hrs.	16 CARS/24 hrs.		
Test Description	BASELINE	PART.	BASELINE	BASELINE		
Pre Heater Temp.						
T/C #3	240	245	255	252		
#10	440	470	466	470		
#14	784	800	818	814		
#15	875	880	903	899		
Main Furnace Temperature						
T/C #16	929	940	964	958		
#19	1134	1160	1182	1172		
#22	1412	1440	1460	1450		
#25	1722	1725	1715	1720		
#27	1910	1905	1904	1899		
#29	2010	2000	2000	1990		
Rapid Cooling System						
T/C #32	1218	1195	1180	1192		
#34	1228	1230	1245	1240		
#37	1141	1140	1167	1163		
#39	1050	1050	1071	1071		
Exit End Recirc. System						
T/C #43	645	645	680	660		

Rapid Cooling Fan Temp.	460	430	441	439		
Final Cooling Fan Temp.	410	410	405	418		
Furnace Pressure, in. W.C.	+.075	+.075	+.072	+.07		
Fuel Flow	15:58					
Start	34,724,000	35,595,000	36,535,000			
Time		10:48	11:47			
End	34,760,000	36,736,000		36,647,000		
Time	16:50	1622		1425		
South side burners in service	28	28	28	28		
North side burners in service	26		26	26		

Location 1

Sampling and Gas Chromatographic Analysis

Non-Combustible Gases

Carbon Dioxide	0.35 (% by volume)
Oxygen	0.12
Nitrogen	0.37
Water Vapor	0.050

Combustible Gases

Methane	94.52
Ethane	4.26
Propane	0.20
i-Butane	0.025
n-Butane	0.037
Pentanes	0.032
Hexanes	0.032

Heating Value	1042 BTU dry/SCF
Gas Density (air=1.00)	0.575

PARTICULATE EMISSION CALCULATIONS

Test No. 1-2 Date 4-7-76 Location 1 Engr. H. BUENING / W. CARTER

Unit No. KILN #2 Fuel NAT. GAS Load JOY METHOD #5

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 30.00 in. Hg

Tot. Liquid Collected, V_{lc} 81.3 ml Total Particulate, M_n 41.4 m gm

Velocity Head, ΔP .06 iwg Stack Temp., Ts 595 °R Stack Area, As 36 ft^2

Sample Volume, Vm 136.4 ft^3 Stack Press., Psg -.73 iwg Excess O_2, XO_2% 16.7 %

Orifice Press. Diff., H 1.18 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 182 min Nozzle Dia., Dn ½ in. Meter Temp., T_m 593 °R

*1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	137.07	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	3.85	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.027	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	.00465	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	6.66×10^{-7}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	1.067×10^{-2}	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	407.27	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Ps \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	862.6	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	27680	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	26933	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	1.076	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	497.6	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	2.9×10^{-2}	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	12.44	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	73.8	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

*Multiply Vm_{std} by $530/T_m$ (°F) if meter not temp. compensated.

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test No. 1 - 2 (Inlet, Outlet) Location _____
Box No. 1 Test Date 4-7-76
Test Description: BASELINE

Dry Gas Meter Vol (ft3)
Final 780.82
Initial 644.41
Total 136.41

Impinger Water Vol (ml) TOTAL V_{lc} = 81.3

	1	2	3	Total	silica gel
Final	182	68	2	252	653.1
Initial	100	100	0	200	623.8
Δ Vol	82	-32	2	52	29.3

							Filter No.	Blank No.
Beaker No.		1	2	3	4	5	1	2
Date Weighed		4-7-76	4-7-76	4-7-76	4-7-76	4-7-76	4-7-76	4-7-76
Tare Wt.	1	100.1154	101.6268	101.4130	99.2660	98.9380	.8000	.8311
	2	100.1151	101.6265	101.4129	99.2657	98.9376	.8000	.8311
	3	100.1150	101.6264	101.4126	99.2654	98.9376	.8000	.8312
	4							
	5							
	6							
	Avg	100.1152	101.6266	101.4128	99.2657	98.9378	.8000	.8311
Bottle No.		1	2	3				
Content		Impinger (Water)	Probe (Acetone)	Probe (Water)	~~Cyclone~~ (Acetone)	~~Blank~~ (Dry)		
Rinse (ml)		200 ml 150 ml 80 ml	200 ml 100 ml	200 ml 145 ml	BLANK 100 mL	H_2O BLANK 100 mL		
Date Weighed or 250 Bake)		4-9-76	4-9-76	4-9-76	4-9-76	4-9-76	4-9-76	4-9-76
Final Wt. 250	1	100.1219	101.6272	101.4178	99.2618	98.9347	.8282	.8315
	2	100.1224	101.6277	101.4180	99.2618	98.9347	.8284	.8315
	3	100.1225	101.6278	101.4182	99.2618	98.9347	.8288	.8316
	4							
	5							
	6							
	Avg	100.1223	101.6276	101.4180	99.2618	98.9347	.8286	.8315
Residue Wt Final 250 Tare)								
Date Weighed or 650 Bake)								
Final Wt. 650	1							
	2							
	3							
	4							
	5							
	6							
	Avg							
Residue Wt. Final 650 Tare)								
		Δ= .0071	Δ=.0010	Δ=.0052	Δ=-.0039	Δ=.0031	Δ=.0285	Δ=.0004

Comments:

.0071
.0010
.0052
.0285
-.0039
0.0414 g

K V B, INC.

STACK DATA

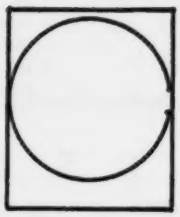
Test No. 1-2
Engr. W. CARTER
TECH. H. BUENING
R. PIONESSA

Date 4-7-76 Location 1 Unit No. KILN 2 Fuel NAT. GAS.

Load 16/P 24 hrs. K#/hr or MBtu/hr Filter No. 1 BLANK 2

Sample Box No. 1 Meter Box No. 1 Probe No. 1 Probe Length 4'

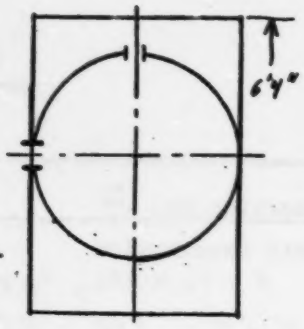
Filter Heater Setting 3
Probe Heater Setting 2
Stack Moisture ____ %
Ambient Temperature ____ °F
Nozzle Diameter 1/2 in.
Atmospheric Pressure 30.00 in.Hg
Weather SUNNY WARM
Stack Gas Pressure, Ps -.73 iwg
Abs. Stack Press., AP=P_s+407= ____ iwga
Stack Gas Sp. Gravity, Gs ____ n.d.
Stack Area, As ____ ft^2



Remarks
Final Meter: 0780.82
Initial Meter: 0644.41
136.41

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
1039	644.41	9.5	.07	1.35	150	100	190	320	110
1200	709.00	8.5	.06	1.19		80	250	290	140
1315	764.00	7	.05	1.00	120	85	270	310	150
1341	780.82								
Total					135 °F				
Avg.					°F + 460				

Ts= 595 °R



SMOKESTACK FLOW PROFILE

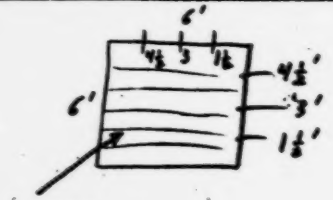
TEST NO. 1-1
LOCATION NO.
DATE APRIL 6, 1976
SAMPLING LOCATION FURNACE OUTLET STACK
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) BAROMETRIC PRESS, in.Hg
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) STACK PRESS., P_s, iwg -.73
STACK I.D. (DISTANCE A - DISTANCE B) STK. GAS SP. GRAVITY, G_s
NEAREST UPSTREAM DISTURBANCE
NEAREST DOWNSTREAM DISTURBANCE

TRAVERSE POINT NUMBER	% OF STACK DIAMETER	DISTANCE FROM INSIDE WALL (FEET)	VELOCITY HEAD (Δp_s), in. H_2O	$\sqrt{\Delta p_s}$	STACK TEMPERATURE (T_s, °F)	OXYGEN % %	STACK GAS SPEED, Vs ft/min
1. 1.5 FEET		1.5	0.03	.173	155		
2. 1.5		3	0.14	.374	155		
3. 1.5		4.5	.05	.224	150		
4. 3		1.5	.10	.316	160		
5. 3		3	.01	.100	135		
6. 3		4.5	.09	.300	120		
7. 4.5		1.5	(-).2	0	120		
8. 4.5		3	.10	.316	120		
9. 4.5		4.5	.08	.283	120		
10.							
11.			Σ	2.086			
12.			$n = 9$				
13.			AVG. $\sqrt{\Delta p_s}$	= .232			
14.		VP	$(\sqrt{\Delta p_s})^2$	= .054			
15.							
16.							
17.							
18.							
Average					187		
					+ 460		
					597		

STACK GAS SPEED, $V_s = 174\ F_p \sqrt{\Delta P (T_s + 460)\ \left(\frac{407}{P_s}\right)\ \left(\frac{1.00}{G_s}\right)}$ (Average)

DRY BULB = 97°F
WET BULB = 74°F
R.H. = 33%

$V_s = 174 \times .83 \times .232 \sqrt{597}$
$= 819$ fpm



60-23
rev. 11/74

INTERNAL COMBUSTION ENGINE DESIGN DATA

Location No. 2 Unit No. 16

Unit Description

8 CYLINDER, TWO STROKE CLARK RECIPROCATING, TYPE HRA-8, WITH 880 H.P. GAS ENGINE DRIVE, 10.56 MMBTU/HR HEAT INPUT.

Installation Date	1943
Test Fuel	NATURAL GAS
Fuel Temperature (°F)	AMBIENT
Primary Air Temp. (°F)	AMBIENT
Air Supply	NATURAL ASPIRATED, LOOP SCAVANGED WITH PUMP
Engine Speed (RPM)	NORMAL 250 - MAX. 300

Comments:

MOBILE LABORATORY DATA

Test No._____

Test No. 2-1 Date 4-20-76 Location 2 Engr. WAC

Unit No._____ Fuel NAT. GAS Capacity 880 HP

Unit Type_____ Burner Type_____

1. Test No.	1		2		3		4		5	
2. Date										
3. Time	1200		1300		1330				1440	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	13.8		12.7		12.5		12.5		12.7	
9. NOx (hot) read/3% O_2 (ppm)*			845	1832	830	1758	825	1747	900	1952
10. NO (hot) read/3% O_2 (ppm)*			790	1713	800	1694	785	1662	830	1800
11. NO_2 (hot) read/3% O_2 (ppm)*			55	119	30	64	40	85		152
12. NO (cold) read/3% O_2 (ppm)*	668	1670	750	1626	900	1906	850	1800	805	1746
13. Carbon Dioxide (%)	5.3		6.0		6.0		6.0		5.9	
14. Carbon Monoxide (ppm) uncor/cor*	430	1075	530	1149	470	995	500	1059	350	759
15. Hydrocarbon (ppm) uncor/cor*										
16. Sulfur Dioxide (ppm) uncor/cor*										
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	79									
19. Dew Point Temp. (°F/°C)	66									
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)	51									
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 2-1 Date 4-20-76 Location 2 Engr. WAC

Unit No._____ Fuel NAT. GAS Capacity 880 HP

Unit Type_____ Burner Type_____

1. Test No.	6											
2. Date												
3. Time	1500											
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position												
8. Oxygen (%)	12.75											
9. NOx (hot) read/3% O_2 (ppm)*	910	1985										
10. NO (hot) read/3% O_2 (ppm)*	825	1800										
11. NO_2 (hot) read/3% O_2 (ppm)*		185										
12. NO (cold) read/3% O_2 (ppm)*	790	1724										
13. Carbon Dioxide (%)	5.85											
14. Carbon Monoxide (ppm) uncor/cor*	360	785										
15. Hydrocarbon (ppm) uncor/cor*												
16. Sulfur Dioxide (ppm) uncor/cor*												
17. Smoke Spot (Bacharach)												
18. Atmos. Temp. (°F/°C)												
19. Dew Point Temp. (°F/°C)												
20. Atmos. Pressure (in. Hg)												
21. Relative Humidity (%)												
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 2-2 Date 4-21-76 Location 2 Engr._____

Unit No._____ Fuel NAT. GAS Capacity 880 HP

Unit Type_____ Burner Type_____

1. Test No.	2-2									
2. Date										
3. Time	1300		1330		1350		1410		1440	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	13.0		13.25		13.3		13.25		13.3	
9. NOx (hot) read/3% O_2 (ppm)*	910	2048	925	2148	900	2104	865	2009	900	2104
10. NO (hot) read/3% O_2 (ppm)*	860	1935	850	1974	820	1917	800	1858	825	1928
11. NO_2 (hot) read/3% O_2 (ppm)*	50	113	75	174	80	187	65	151	75	176
12. NO (cold) read/3% O_2 (ppm)*	862	1940	850	1974	820	1917	775	1800	800	1870
13. Carbon Dioxide (%)	5.8		5.7		5.6		5.6		5.7	
14. Carbon Monoxide (ppm) uncor/cor*	275	619	275	639	275	643	255	592	260	608
15. Hydrocarbon (ppm) uncor/cor*	6000		6300		6300		6600		6500	
16. Sulfur Dioxide (ppm) uncor/cor*										
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	77									
19. Dew Point Temp. (°F/°C)	67									
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 2-3 Date 4/22/76 Location 2 Engr._____

Unit No._____ Fuel NAT. GAS Capacity 880 HP

Unit Type_____ Burner Type_____

1. Test No.	2-3A		2-3 B		2-3 C		2-4 A		2-4 B	
2. Date										
3. Time	1010		1025		1055		1300		1400	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	13.15		12.85		13.5		13.0		13.2	
9. NOx (hot) read/3% O_2 (ppm)*	780	1789	745	1645	740	1776	730	1643	755	1742
10. NO (hot) read/3% O_2 (ppm)*	715	1639	675	1491	685	1644	670	1508	680	1569
11. NO_2 (hot) read/3% O_2 (ppm)*	65	149	70	155	55	132	60	135	75	173
12. NO (cold) read/3% O_2 (ppm)*	710	1628	670	1480	670	1608	655	1474	650	1500
13. Carbon Dioxide (%)	5.9		6.1		5.7		5.8		5.5	
14. Carbon Monoxide (ppm) uncor/cor*	285	654	310	685	240	576	300	675	260	600
15. Hydrocarbon (ppm) uncor/cor*	3500		2700		4250		3000		3800	
16. Sulfur Dioxide (ppm) uncor/cor*										
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 2-5 Date 4-23-76 Location 2 Engr. _____

Unit No. _____ Fuel NAT. GAS Capacity 880 HP

Unit Type _____ Burner Type _____

1. Test No.	2-5A		2-5B		2-5C		2-5D		AMBIENT	
2. Date										
3. Time	0915		1015							
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	13.3		13.3		13.3		13.45		20.95	
9. NOx (hot) read/3% O_2 (ppm)*	620	1449	630	1473	605	1414	630		2.0	
10. NO (hot) read/3% O_2 (ppm)*	500	1169	550	1286	530	1239	540		1.0	
11. NO_2 (hot) read/3% O_2 (ppm)*	120	281	80	187	75	175	90		1.0	
12. NO (cold) read/3% O_2 (ppm)*	505	1180	560	1309	520	1216	510		1.0	
13. Carbon Dioxide (%)	5.75		5.8		5.9		5.7		0.1	
14. Carbon Monoxide (ppm) uncor/cor*	310	725	275	643	285	666	250		0	
15. Hydrocarbon (ppm) uncor/cor*	5000		4200		3600		4500		125	
16. Sulfur Dioxide (ppm) uncor/cor*										
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

OPERATING DATA

Location 2

Date: 4/20/76 Test: BASELINE

Data Taken By: WAC Test No.: 2-1

Time	1200	1305	1400	1500	
Engine Speed (RPM) NOMINAL / FLUCTUATIONS	260 / 250/290	260 / 260/290	270 / 260/300	260 / 250/300	
Current Exhaust Temp. (°F)					
No. 1	700	720	700	700	
No. 2	730	750	750	760	
No. 3	690	700	700	700	
No. 4	640	660	660	630	
No. 5	N/A	700	630	700	
No. 6	630	680	690	540 ?	
No. 7	650	640	650	670	
No. 8	600	580	580	720	
First Stage Inlet Press. (psig)	13	13	13	13	
First Stage Inlet Temp. (°F)	85	86	87	89	
Second Stage Discharge Press. (psig)	72	72	72	72	
Ambient Air Temperature					
Dry Bulb (°F)	82	84	89	78	
Wet Bulb (°F)	68	70	73	65	
Relative Humidity (%)					
Manifold Vacuum (in. Hg)	~6	~6	~6	6	
Barometric Pressure (in. Hg)					

OPERATING DATA

Location 2

Date: 4-21-76 Test: LOAD RANGE

Data Taken By: BUENING Test No.: 2-2

Time	12:35	13:20	13:45	14:10	14:45
Engine Speed (RPM) NOMINAL / FLUCTUATIONS	270 / 260/280	270 / 265/285	275 / 260/290	275 / 250/300	275 / 260/290
Current Exhaust Temp. (°F)					
No. 1	660	645	635	650	645
No. 2	725	715	715	720	725
No. 3	690	690	695	680	685
No. 4	720	715	715	710	715
No. 5	660	665	660	655	655
No. 6	—	—	—	—	—
No. 7	630	630	630	620	625
No. 8	730	745	725	725	730
First Stage Inlet Press. (psig)	13	12	11	10	13
First Stage Inlet Temp. (°F)	82	82.5	82.5	82	82
Second Stage Discharge Press. (psig)	72	68	67	67	67
Ambient Air Temperature					
Dry Bulb (°F)	78	78	78	78	78
Wet Bulb (°F)	67	67	65	65	64
Relative Humidity (%)	57	57	50	50	47
Manifold Vacuum (in. Hg)	~6.5	~6.5	~6.5	~6.5	~6.5
Barometric Pressure (in. Hg)	29.88	29.88	29.88	29.90	29.90

OPERATING DATA

Location 2

Date: 4-22-76

Test: SPEED INCREASE

Data Taken By: BUENING

Test No.: 2-3

Time	9:45	10:25	10:55		
Engine Speed (RPM) NOMINAL FLUCTUATIONS	270 260/280	300 –	250 –		
Current Exhaust Temp. (°F)					
No. 1	625	660	595		
No. 2	685	710	660		
No. 3	675	705	580		
No. 4	710	730	675		
No. 5	–	715	645		
No. 6	675	740	610		
No. 7	655	655	605		
No. 8	700	695	675		
First Stage Inlet Press. (psig)	14.5	14.5	14.5		
First Stage Inlet Temp. (°F)	82	84	83.5		
Second Stage Discharge Press. (psig)	67	67	67		
Ambient Air Temperature					
Dry Bulb (°F)	76	74	74		
Wet Bulb (°F)	68	63	63		
Relative Humidity (%)	67	55	55		
Manifold Vacuum (in. Hg)	~6	~7.5	6		
Barometric Pressure (in. Hg)	29.95	29.95	30.0		

OPERATING DATA

Location 2

Date: 4-22-76

Data Taken By: BUENING

Test: AIR ADJUSTMENT

Test No.: 2-4

Time	12:55	13:55			
Engine Speed (RPM) NOMINAL FLUCTUATIONS	295 –	275			
Current Exhaust Temp. (°F)					
No. 1	665	625			
No. 2	715	690			
No. 3	685	615			
No. 4	730	700			
No. 5	720	690			
No. 6	735	655			
No. 7	675	640			
No. 8	690	730			
First Stage Inlet Press. (psig)	13.5	14.5			
First Stage Inlet Temp. (°F)	84	84			
Second Stage Discharge Press. (psig)	67	67			
Ambient Air Temperature					
Dry Bulb (°F)	77	76			
Wet Bulb (°F)	65	64			
Relative Humidity (%)	53	52			
Manifold Vacuum (in. Hg)	~6.5	~6			
Barometric Pressure (in. Hg)	30.0	30.0			

OPERATING DATA

Location 2

Date: 4-23-76

Test: FUEL AIR ADJUSTMENT

Data Taken By: BUENING

Test No.: 2-5

Time	8:45	10:15	11:00		
Engine Speed (RPM)	260	265	280		
Current Exhaust Temp. (°F)					
No. 1	685	645	680		
No. 2	700	645	720		
No. 3	675	660	670		
No. 4	655	675	670		
No. 5	660	660	680		
No. 6	635	650	660		
No. 7	660	660	665		
No. 8	660	730	730		
First Stage Inlet Press. (psig)	14.5	14.2	12.3		
First Stage Inlet Temp. (°F)	83	84	83		
Second Stage Discharge Press. (psig)	66	66	66		
Ambient Air Temperature					
Dry Bulb (°F)	72	75	75		
Wet Bulb (°F)	63	65	64		
Relative Humidity (%)	61	59	56		
Manifold Vacuum (in. Hg)	~6	~6	~6.5		
Barometric Pressure (in. Hg)	30.07	30.08	30.08		
FUEL PRESSURE	39	32	39		

Gas Composition at Location 2

Methane	89.66 mol %
Ethane	3.30
Propane	3.05
Iso-Butane	0.87
n-Butane	1.52
Pentane +	1.60
Heat Content	1225 Btu/ft^3

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4/20/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-1 Personnel: _____

Fuel: Natural Gas _____

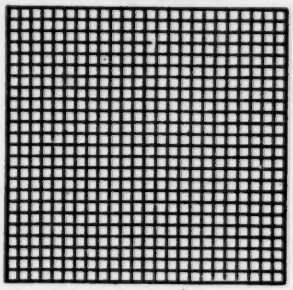
Barometric Press. (in. Hg): 29.90

Absolute Static Press. in Stack (in. Hg): 29.93 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\, C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		.5	1.8	660	1120	29.0	130	
		1.75	2.1			↓	141	
		3.5	2.2				144	
		8.5	2.2				144	
		10.25	2.4				150	
		11.5	2.4				141	

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$(V_s)_{avg} = 142$

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 4/21/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-2 Personnel: GRF

Fuel: NATURAL GAS _____

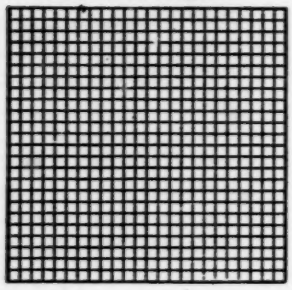
Barometric Press. (in. Hg): 29.89

Absolute Static Press. in Stack (in. Hg): 29.95 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\, C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1230		.6	1.8	625	1085	29.0	128	
		1.9	2.0		1082		135	
		3.9	2.2		1079		142	
		9.3	2.4		1076		147	
		11.3	2.2		1073		141	
		12.7	1.6	610	1070	↓	120	

6002-13

$(V_s)_{avg} = 136$

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4/21/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-2 Personnel: GRF

Fuel: NATURAL GAS _____

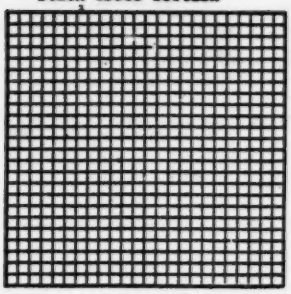
Barometric Press. (in. Hg): 29.89

Absolute Static Press. in Stack (in. Hg): 29.94 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\, C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1315			2.0	600	1060	29.0	134	
			2.3		1050		143	
			2.3		1040		143	
			2.4		1030		143	
			2.3		1020		140	
			1.8	550	1010	↓	124	

6002-13

$(V_s)_{avg} = 138.$

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4/21/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-2 Personnel: GRF

Fuel: NATURAL GAS _____

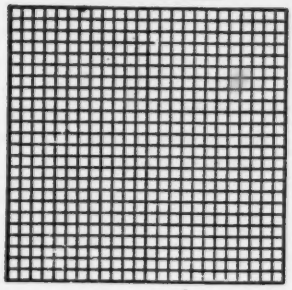
Barometric Press. (in. Hg): 29.89

Absolute Static Press. in Stack (in. Hg): 29.93 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Point Port	Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1335			2.0	575	1035	29.0	132	
			2.1	572	1032		135	
			2.1	569	1029		135	
			2.3	566	1026		141	
			2.2	563	1023		138	
			1.6	560	1020	↓	117	

6002-13

$(V_s)_{avg} = 133$

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 4/21/76

Location: 2

Unit: _____

Test: 2-2 Personnel: GRF

Fuel: NATURAL GAS

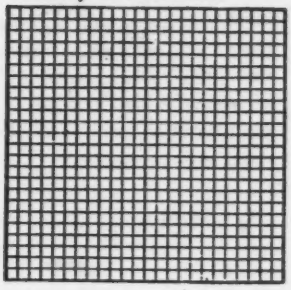
Barometric Press. (in. Hg): 29.89

Absolute Static Press. in Stack (in. Hg): 29.94 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Point Port	Traverse Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1400			2.1	575	920	29.0	127	
			2.3		↓	↓	133	
			2.3				133	
			2.4				136	
			2.4				136	
			1.8	575	↓	↓	118	

6002-13

$(V_s)_{avg} = 130$

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4/21/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-2 Personnel: GRF

Fuel: NATURAL GAS _____

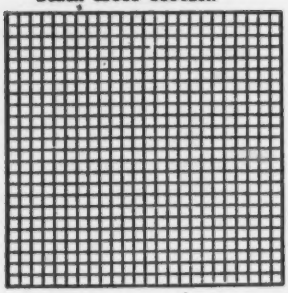
Barometric Press. (in. Hg): 29.90

Absolute Static Press. in Stack (in. Hg): 29.94 (P_s)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1425			1.8	575	1035	29.0	125	
			2.1	572	1032	↓	135	
			2.1	569	1029	↓	135	
			2.2	566	1026	↓	138	
			2.2	563	1023	↓	138	
			1.7	560	1020	↓	121	

6002-13

$(V_s)_{avg} = 132$

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4/22/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-3 Personnel: GRF

Fuel: NATURAL GAS _____

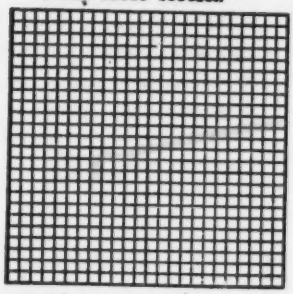
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
0955			1.7	610	1070	29.0	124	
			2.2	↓	↓	↓	141	
			2.3				144	
			2.3				144	
			2.3	↓	↓	↓	144	
			1.8	610	1070		127	

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 4/22/76

Location: 2

Unit: _____

Test: 2-3 Personnel: ORF

Fuel: NATURAL GAS

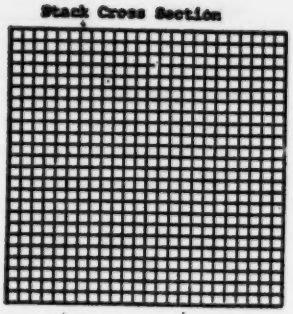
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1015			2.4	640	1100	29.0	149	
			2.5	632	1092		151	
			2.6	624	1084		154	
			2.6	616	1076		153	
			2.5	608	1068		150	
			2.1	600	1060		137	

6003-13

$(V_s)_{avg} = 149$

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 4/22/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-3 Personnel: GRF

Fuel: NATURAL GAS _____

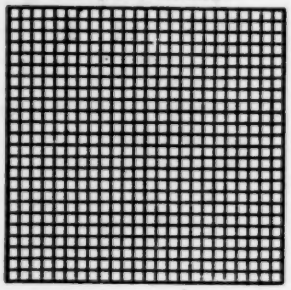
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\, C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Point Port	Traverse Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1045			1.8	590	1050	29.0	126	
			2.1		1047		136	
			2.2		1044		139	
			2.2		1041		139	
			2.0		1038		132	
			1.6	575	1035	↓	118	

6002-13

$(V_s)_{avg} = 132$

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 4/22/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-4 Personnel: GRF

Fuel: NATURAL GAS _____

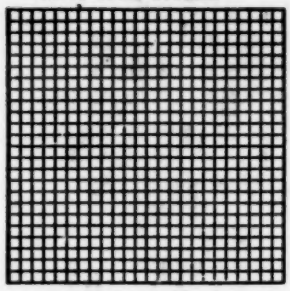
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1245			2.4	550	1010	29.0	142.8	
			2.6				148.6	
			2.6				148.6	
			2.8				154.2	
			2.6				148.6	
			2.2	550	↓	↓	136.7	

6003-13

$(V_s)_{avg} = 146.6$

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4/22/76

Location: 2

Unit: _____

Test: 2-4 Personnal: GRF

Fuel: NATURAL GAS

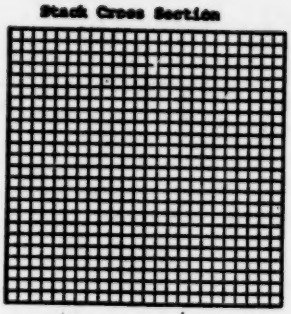
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta p}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) Δp	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1345			2.0	525	985	29.0	128.7	
			2.2		985		134.9	
			2.3		985		138.0	
			2.3		985		138.0	
			2.1		985		131.9	
			1.8	525	985	↓	122.1	

6002-13

$(V_s)_{avg} = 132.3$

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 4/23/76

Location: 2

Unit: _____

Test: 2-5 Personnel: GRF

Fuel: NATURAL GAS

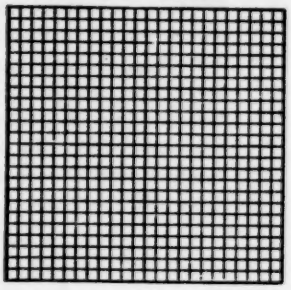
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\, C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
0850			1.9	640	1100	29.0	132	
			2.1	632	1092		139	
			2.1	624	1084		138	
			2.2	616	1076		141	
			2.0	608	1068		134	
			1.9	600	1060	↓	130	

$(V_s)_{avg} = 136$

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4/23/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-5 Personnel: GRF

Fuel: NATURAL GAS _____

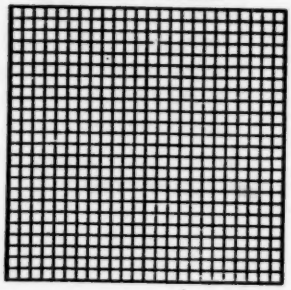
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1000			1.6	600	1060	29.0	119	
			2.0	605	1065		134	
			2.1	610	1070		137	
			2.1	615	1075		138	
			2.1	620	1080		138	
			1.8	625	1085	↓	128	

$(V_s)_{avg} = 132$

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 4/23/76 _____

Location: 2 _____

Unit: _____ _____

Test: 2-5 Personnel: GRF

Fuel: NATURAL GAS _____

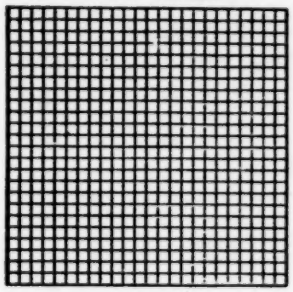
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\, C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1050			2.4	650	1110	29.0	150	
			2.5		1110		153	
			2.7		1110		159	
			2.6		1110		156	
			2.6		1110		156	
			2.2	650	1110		143	

6002-13

$(V_s)_{avg} = 153$

ROTARY KILN DESIGN DATA

Location No. 3 Unit No. 1

Unit Description

THE KILN WAS MANUFACTURED BY ALLIS-CHALMERS. PARTICULATES ARE REMOVED WITH A MULTICLONE SEPERATOR AT THE KILN EXIT AND A BAGHOUSE DOWNSTREAM OF THE MULTICLONE

Installation Date	1963
Process Capacity	~55 TONS/HR
Burner Description	GAS GUN + PULVERIZED COAL BURNERS
Test Fuel	NAT. GAS IN COMBINATION WITH COKE
Fuel Temp. at Burner	COKE ~160° F NAT. GAS AMBIENT

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 3-1 Date 5-5-76 Location 3 Engr._____

Unit No._____ Fuel COKE, GAS Capacity_____

Unit Type ROTARY KILN Burner Type_____

1. Test No.	3-1		3-1A		3-1B						
2. Date											
3. Time	1120				1400						
4. Load											
5. Process Rate											
6. Flue Diam. or Size, ft											
7. Probe Position											
8. Oxygen (%)	3.1		2.0		1.55						
9. NOx (hot) read/3% O_2 (ppm)*	—		975	924	930	861					
10. NO (hot) read/3% O_2 (ppm)*	—		950	900	925	856					
11. NO_2 (hot) read/3% O_2 (ppm)*	—		25	24	5	5					
12. NO (cold) read/3% O_2 (ppm)*	1010	1016	1070	1014	1015	939					
13. Carbon Dioxide (%)	17.5		17.4		17.6						
14. Carbon Monoxide (ppm) uncor/cor*	60	60	55	52	55	51					
15. Hydrocarbon (ppm) uncor/cor*	16		20		50						
16. Sulfur Dioxide (ppm) uncor/cor*	11		4		4						
17. Smoke Spot (Bacharach)											
18. Atmos. Temp. (°F/°C)											
19. Dew Point Temp. (°F/°C)											
20. Atmos. Pressure (in. Hg)											
21. Relative Humidity (%)											
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 3-2 Date 5-6-76 Location 3 Engr. _____

Unit No. _____ Fuel COKE/GAS Capacity _____

Unit Type ROTARY KILN Burner Type _____

1. Test No.	3-2 U		3-2 D		3-2A-U		3-2A-D		3-2B-D	
2. Date										
3. Time	1300		1310		1350		1400		1520	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	1.95		13.0		2.05		13.6		13.65	
9. NOx (hot) read/3% O_2 (ppm)*	835	789			900	855				
10. NO (hot) read/3% O_2 (ppm)*	820	775			890	845				
11. NO_2 (hot) read/3% O_2 (ppm)*	15	14			10	9				
12. NO (cold) read/3% O_2 (ppm)*	900	850	310	698	1000	950	365	888	380	930
13. Carbon Dioxide (%)	18.1		10.7		17.1		9.6		9.7	
14. Carbon Monoxide (ppm) uncor/cor*	45	43	20	45	40	38	15	36	18	44
15. Hydrocarbon (ppm) uncor/cor*	25		11		28		12		14	
16. Sulfur Dioxide (ppm) uncor/cor*	17		15		12		12		15	
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	65									
19. Dew Point Temp. (°F/°C)	57									
20. Atmos. Pressure (in. Hg)	28.95									
21. Relative Humidity (%)	62									
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

U = UPSTREAM

D = DOWNSTREAM

MOBILE LABORATORY DATA Test No._____

Test No. 3-3 Date 5-7-76 Location 3 Engr._____

Unit No._____ Fuel COKE, GAS Capacity_____

Unit Type ROTARY KILN Burner Type_____

1. Test No.	3-3A-U		3-3B-U		3-3C-U					
2. Date										
3. Time	1000		1315		1415					
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	1.5		1.2		1.65					
9. NOx (hot) read/3% O_2 (ppm)*	890	822	975	886	930	865				
10. NO (hot) read/3% O_2 (ppm)*	860	794	950	864	970	902				
11. NO_2 (hot) read/3% O_2 (ppm)*	30	28	25	23	40	37				
12. NO (cold) read/3% O_2 (ppm)*	930	858	1000	909	1070	995				
13. Carbon Dioxide (%)	18.6		18.0		17.4					
14. Carbon Monoxide (ppm) uncor/cor*	30	28	35	32	30	28				
15. Hydrocarbon (ppm) uncor/cor*	23		11		10					
16. Sulfur Dioxide (ppm) uncor/cor*	19		22		21					
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 3-3 Date 5-7-76 Location 3 Engr._____

Unit No._____ Fuel COKE, GAS Capacity_____

Unit Type ROTARY KILN Burner Type_____

1. Test No.	3-3B-V											
2. Date												
3. Time	1530											
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position												
8. Oxygen (%)	1.55											
9. NOx (hot) read/3% O_2 (ppm)*	930	861										
10. NO (hot) read/3% O_2 (ppm)*	910	842										
11. NO_2 (hot) read/3% O_2 (ppm)*	20	19										
12. NO (cold) read/3% O_2 (ppm)*	1040	962										
13. Carbon Dioxide (%)	17.0											
14. Carbon Monoxide (ppm) uncor/cor*	40	37										
15. Hydrocarbon (ppm) uncor/cor*	40											
16. Sulfur Dioxide (ppm) uncor/cor*	20											
17. Smoke Spot (Bacharach)												
18. Atmos. Temp. (°F/°C)												
19. Dew Point Temp. (°F/°C)												
20. Atmos. Pressure (in. Hg)												
21. Relative Humidity (%)												
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

KVB

LOCATION NO. 3
CONTROL ROOM DATA SHEET

DATE 5-5-76

TEST NO. 3-1 TIME 13:15

Parameter	Units	Meter Legend	Meter No.	Reading
1. Coke Rate	tons/hr	"Coal Mill Feed Rate"	H3-K2-BS1	5.8
2. Cyclone Tempering Air Temp.	°F			605
3. Coal Mill Outlet Temp.				156
4. Coal Mill Inlet Temp.				290 ~~~40~~
5. Coal Mill Motor Amp				21
6. Coal Mill Inlet Pressure				2
7. Coal Mill Outlet Pressure				9.0 ~~2.7~~
8. Coal Mill Fan Inlet Damper	% OPEN			45
9. Fan Amps				130
10. Fan Damper Position			H5-2-D01-POSR	33
11. Kiln Exit O_2	%		H3-$2O_2$R	1.5
12. Klin Feeder Speed	RPM			20
13. Kiln Speed	RPH			95
14. Max. Kiln Shell Temp.	°F			520
15. Cooler Undergrate Air Temp				200
16. Cooler Undergrate Air Pressure	"H_2O			7.2
17. Material Temp			H3-2-TSM	2550
18. Gas Fuel Rate	SCFH $\times 10^5$ (70°F)			70
19. Clinker Rate	tons/hr	"Clinker Belt Scale Int"	H2-2-BSI-INT	47
20. Feed Rate	tons/hr	(From Operator)		~50

RVB

LOCATION NO. 3
CONTROL ROOM DATA SHEET

DATE 5-6-76

TEST NO. 3-2 A TIME 13:35

Parameter	Units	Meter Legend	Meter No.	Reading
1. Coke Rate	tons/hr	"Coal Mill Feed Rate"	H3-K2-BS1	5.5
2. Cyclone Tempering Air Temp.	°F			625
3. Coal Mill Outlet Temp.				157
4. Coal Mill Inlet Temp.				320 ~~100~~
5. Coal Mill Motor Amp				24
6. Coal Mill Inlet Pressure				1.9
7. Coal Mill Outlet Pressure				8.6 ~~2.6~~
8. Coal Mill Fan Inlet Damper				50
9. Fan Amps				125 ÷ 130
10. Fan Damper Position			H5-2-D01-POSR	33
11. Kiln Exit O_2	%		H3-$2O_2$R	1.7 ÷ 1.9
12. Klin Feeder Speed	RPM			20
13. Kiln Speed	RPH			94
14. Max. Kiln Shell Temp.	°F			580
15. Cooler Undergrate Air Temp	°F			200
16. Cooler Undergrate Air Pressure	"H_2O			7.5
17. Material Temp			H3-2-TSM	2600
18. Gas Fuel Rate	SCFH $\times 10^3$ (70°F)			71
19. Clinker Rate	tons/hr	"Clinker Belt Scale Int"	H2-2-BSI-INT	44
20. Feed Rate	tons/hr	(From Operator)		~47
21. BAGHOUSE INLET TEMP. 42	°F			555

5/4/76 - 6002

KVB

LOCATION NO. 3
CONTROL ROOM DATA SHEET

DATE 5-6-76

TEST NO. 3-2 B TIME 15:18

Parameter	Units	Meter Legend	Meter No.	Reading
1. Coke Rate	tons/hr	"Coal Mill Feed Rate"	H3-K2-BS1	5.7
2. Cyclone Tempering Air Temp.	°F			610 °F
3. Coal Mill Outlet Temp.				157 °F
4. Coal Mill Inlet Temp.				300 ~~95~~ °F
5. Coal Mill Motor Amp				24
6. Coal Mill Inlet Pressure				1.9
7. Coal Mill Outlet Pressure				8.6 ~~2.6~~
8. Coal Mill Fan Inlet Damper				50
9. Fan Amps				130
10. Fan Damper Position			H5-2-D01-POSR	33
11. Kiln Exit O_2	%		H3-$2O_2$R	1.1 ÷ 1.4
12. Klin Feeder Speed	RPM			20
13. Kiln Speed	RPH			94
14. Max. Kiln Shell Temp.	°F			580
15. Cooler Undergrate Air Temp				198
16. Cooler Undergrate Air Pressure				6"
17. Material Temp			H3-2-TSM	2630
18. Gas Fuel Rate	SCFH (70°F)			71
19. Clinker Rate	tons/hr	"Clinker Belt Scale Int"	H2-2-BSI-INT	53
20. Feed Rate	tons/hr	(From Operator)		~58
21. BAGHOUSE INLET TEMP.	°F			550

5/4/76 - 6002

LOCATION NO. 3
CONTROL ROOM DATA SHEET

DATE 5-7-76

TEST NO. 3-3 TIME 1255

Parameter	Units	Meter Legend	Meter No.	Reading
1. Coke Rate	tons/hr	"Coal Mill Feed Rate"	H3-K2-BS1	6.0 (225 TONS @ 1300)
2. Cyclone Tempering Air Temp.	°F			620
3. Coal Mill Outlet Temp.	°F			160
4. Coal Mill Inlet Temp.	°F			360
5. Coal Mill Motor Amp				26
6. Coal Mill Inlet Pressure				1.9
7. Coal Mill Outlet Pressure				8.6
8. Coal Mill Fan Inlet Damper POSITION				54
9. Fan Amps				130
10. Fan Damper Position			H5-2-D01-POSR	54
11. Kiln Exit O_2	%		H3-$2O_2$R	0.8
12. Klin Feeder Speed	RPM			20 RPM
13. Kiln Speed	RPH			96
14. Max. Kiln Shell Temp.	°F			550
15. Cooler Undergrate Air Temp	°F			200
16. Cooler Undergrate Air Pressure	"H_2O			7.2
17. Material Temp			H3-2-TSM	2600
18. Gas Fuel Rate	SCFH (70°F)			70×10^3 SCFH
19. Clinker Rate	tons/hr	"Clinker Belt Scale Int"	H2-2-BSI-INT	92
20. Feed Rate	tons/hr	(From Operator)		—
21. BAGHOUSE INLET TEMP., °F				550 °F

5/4/76 - 6002

LOCATION NO. 3
CONTROL ROOM DATA SHEET

DATE 5-7-76

TEST NO. 3-3 TIME 1403

Parameter	Units	Meter Legend	Meter No.	Reading
1. Coke Rate	tons/hr	"Coal Mill Feed Rate"	H3-K2-BS1	5.6 (TONS 2260 lb @ 1403)
2. Cyclone Tempering Air Temp.	°F			610 °F
3. Coal Mill Outlet Temp.				160
4. Coal Mill Inlet Temp.				340 ?
5. Coal Mill Motor Amp				25
6. Coal Mill Inlet Pressure				2.1
7. Coal Mill Outlet Pressure				8.6 "H_2O
8. Coal Mill Fan Inlet Damper				54
9. Fan Amps				130
10. Fan Damper Position			H5-2-D01-POSR	54
11. Kiln Exit O_2	%		H3-$2O_2$R	1.5
12. Kiln Feeder Speed	RPM			20
13. Kiln Speed	RPM			93
14. Max. Kiln Shell Temp.	°F			580
15. Cooler Undergrate Air Temp				200
16. Cooler Undergrate Air Pressure				8 "H_2O
17. Material Temp			H3-2-TSN	2580 °F
18. Gas Fuel Rate	SCFH (70°F)			70 x 10^3 SCFH
19. Clinker Rate	tons/hr	"Clinker Belt Scale Int"	H2-2-BSI-INT	80
20. Feed Rate	tons/hr	(From Operator)		—
21. BAGHOUSE INLET TEMP., °F				550 °F

5/4/76 - 6002

LOCATION 3

COKE SAMPLE

Ultimate Analysis:	
Carbon, %	82.68
Hydrogen, %	3.67
Nitrogen, %	2.38
Sulfur, %	1.94
Ash, %	6.19
Moisture, %	2.01
Oxygen, % (by difference)	1.13
Heat of Combustion:	
Grass, BTU/lb	13,980
Net, BTU/lb	13,640

GASEOUS FUEL ANALYSIS

Test No _____

Test No 3-2 Date _____ Location Rotary Cement Kiln Dr. Engr _____

Unit No. _____ Fuel Nat Gas Fuel Sample No _____

Fuel Sample Point _____ Fuel Analysis by _____

Gas		% Volume	CF air / CF fuel	Btu(HHV) / CF fuel	CF CO_2 / CF fuel	CF H_2O / CF fuel	CF Prod / CF fuel	lb Prod / CF fuel
CH_4	Methane	88.24 x	0.0955	9.94	0.01	0.02	0.1055	0.000416
C_2H_6	Ethane	7.83 x	0.1671	17.51	0.02	0.03	0.1821	0.000786
C_3H_8	Propane	1.64 x	0.2387	25.19	0.03	0.04	0.2587	0.001171
C_4H_{10}	Butane	0.26 x	0.3103	33.21	0.04	0.05	0.3353	0.001548
C_5H_{12}	Pentane	____ x	0.3819	41.11	0.05	0.06	0.4119	0.001864
C_2H_4	Ethylene	____ x	0.1432	15.80	0.02	0.02	0.1532	0.000726
C_3H_6	Propylene	____ x	0.2148	23.33	0.03	0.03	0.2298	0.001087
C_4H_8	Butylene	____ x	0.2869	31.23	0.04	0.04	0.3068	0.001449
C_5H_{10}	Pentylene	____ x	0.3580	39.16	0.05	0.05	0.3830	0.001813
C_2H_2	Acetylene	____ x	0.1193	14.57	0.02	0.01	0.1343	0.000682
C_6H_6	Benzene	____ x	0.3580	38.48	0.06	0.03	0.3730	0.002017
O_2	Oxygen	____ x	-0.0477				-0.0377	0.000828
N_2	Nitrogen	1.08					0.01	0.000728
CO_2	Carb. Diox	0.85			0.01		0.01	0.001145
CO	Carb. Monox	____ x	0.0239	3.15	0.01		0.0289	0.000724
H_2	Hydrogen	____ x	0.0239	3.18		0.01	0.0289	0.0000522
	Total	100.0	10.22	1065	2.08	11.28	0.047	9502

Theoretical Air:

$\frac{\text{SCF air}}{10^6 \text{ Btu}} = \frac{\text{CF air}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} =$ 9596 SCF air/10^6 Btu @ 70°F, 29.92 in. Hg.

$\frac{\text{WSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{CF Prod}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} =$ 1.059×10^4 Wet SCF Prod/10^6 Btu

$\% \text{ Moisture} = \frac{\text{CF } H_2O}{\text{CF fuel}} \times 100 \Big/ \frac{\text{CF Prod}}{\text{CF fuel}} =$ 18.4 % H_2O

$\frac{\text{DSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{WSCF Prod}}{10^6 \text{ Btu}} \times \frac{(100 - \% \text{ Moisture})}{100} =$ 8637.7 Dry SCF/10^6 Btu

$\% \, CO_2, \text{ dry} = \frac{\text{CF } CO_2}{\text{CF fuel}} \times 100 \Big/ \left(\frac{\text{CF Prod}}{\text{CF fuel}} - \frac{\text{CF } H_2O}{\text{CF fuel}}\right) =$ _____ % CO_2, dry

$K = \frac{[illegible] \times 10^6}{MW \times (\text{DSCF}/10^6 \text{ Btu})}$

$K' = K/430$

lb/10^6 Btu = (ppm @ 3% O_2)/K

ng/J = (ppm @ 3% O_2)/K'

MW	K for lb/10^6 Btu	K' for ng/J
NOx 46	_____	_____
CO 28	_____	_____
HC 16	_____	_____
SOx 64	_____	_____

Data Sheet 6002-6 (Rev. 1)

NP-67 KEYED CALCULATION SHEET*

PARTICULATE EMISSION CALCULATIONS

Test No. 3-2 Date 5-6-76 Location Dry Cement Kiln Engr. WAC

Unit No. KV-2 Fuel Coke/Gas Sampling Train and Method Method 5

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 28.96 (STO 0) in. Hg

Tot. Liquid Collected, V_{lc} 6.5 (STO 1) ml Total Particulate, M_n 3417.6 (STO 2) mgm

Velocity Head, ΔP 0.8 (STO 3) iwg Stack Temp., Ts 1005 (STO 4) °R Stack Area, As 84 (STO 5) ft^2

Sample Volume, Vm 5.58 (STO 6) ft^3 Stack Press., Psg -6 (STO 7) iwg Excess O_2, $\%O_2$ 18.65 (STO 8) %

Orifice Press. Diff., H .62 (STO 9) iwg ~~Stack Gas Sp. Gravity~~ ρ_{flue}/ρ_{air} @ Ts Gs 1.04 (STO A) n.d.

Sample Time, θ 10 (STO B) min Nozzle Dia., Dn 1/4 (STO C) in. Meter Temp., T_m (STO D) °F

Select Fe	Oil (A)	Gas (B)	Coal (C)	Other: Coke & Gas
SC Feet/10^4 Btu	92.2	87.4	98.2	114.2 (D)

Press (E) if meter is not temperature compensated.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	5.40	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	0.31	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	0.54	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	9.746	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.396×10^{-3}	lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	22.36	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	387.7	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	4114	ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsv = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	173 602	WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	169228	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	1.376×10^4	lb/hr
9. $\%O_2$ factor	$\%O_2 f = 2090/(20.9 - \%O_2)$	298.3	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	45.96	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	19763	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	81.	%

*If calculating by hand:
1) Convert T_s and T_m to °R
2) Multiply EQ 1 by 530/T_m(°R) if meter not temperature compensated.
3) $F_m = 2.684 \times 10^{-5} \times F_e$

Data Sheet 6002-4
Revised 2/15/78

PARTICULATE CALCULATION SHEET

Test No. 3-2 Date 5-6-76 Location Test Crew

Box No. 1 Sample Probe Position

Test Description INITIAL PARTICULATE TEST

Dry Gas Meter Vol. (ft^3)

Final 102.504
Initial 1018.24
Total 84.66

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final	104	100	0	204.5	
Initial	100	100	—	200.3	
Δ Vol	4	0	0	2.5	6.5

Beaker No.		1	2	3	4	5	Filter No. 1	Blank No. 2
Date Weighed								
Tare Wt.	1	100.0949	101.6263	101.4107	99.2607	98.8284	0.8408	0.7989
	2	100.0946	101.6241	101.4106	99.2505	98.9239	0.8406	0.7990
	3	100.0945	101.6243	101.4104	99.2504	98.9236	0.8409	0.7991
	4							
	5							
	6							
Avg		100.0947	101.6242	101.4105	99.2505	98.9236	0.8407	0.7990
Bottle No.		2	3	4	1			
Content		Impinger (Water)	Probe (Acetone)	Probe (Water)	Cyclone (Acetone)	Flask (Dry)		
Rinse (ml)		492	482	457	222			
Date Weighed or 250 Bake						5/7/76		
Final Wt. 250	1	100.0995	102.3119	101.4547	99.2862	100.7862	1.6944	0.7989
	2	100.0992	102.3115	101.4547	99.2857	100.7858	1.6944	0.7989
	3	100.0991	102.3116	101.4545	99.2859	100.7859	1.6944	0.7990
	4							
	5							
	6							
Avg		100.0993	102.3117	101.4547	99.2859	100.7860	1.6944	0.7990
Residue wt Final 250-Tare								
Date Weighed or 650 Bake								
Final Wt. 650	1							
	2							
	3							
	4							
	5							
	6							
Avg								
Residue Wt Final 650-Tare		0.0046	0.0875	0.0042	0.0354	1.8124		

Comments:

Data Sheet 6002-3

Test No. 3

CASCADE IMPACTOR DATA SHEET

TEST RUN NO. 3-3 LOCATION 3 DATE 5-7-76 TIME 13:50

IMPACTOR NO. 1 CYCLONE NO. 1 OPERATOR _____

SAMPLE POINT LOCATION DOWNSTREAM OF MULTICLONE

SUBSTRATE COATING NONE FUEL COKE, GAS KLINKER FLOW ~~TEST LOAD~~ 60 T/hr klb/hr

IMPACTOR ORIENTATION HORIZ. FLOW THRU IMPACTOR 0.07 CFM

FLUE STATIC PRESSURE -6 inH_2O, VELOCITY 65 ft/sec.

NOZZLE DIA. 2 mm IMPACTOR PRESSURE DROP 13¾ "H_2O END TIME 13:40

GAS METER END 7.01 CF START TIME 13:50

GAS METER START 0 CF DURATION 10 MIN

GAS VOLUME 7.01 CF FLOW RATE 0.07 CFM

WET BULB 64 °F

AMBIENT TEMPERATURE 77 °F PRESSURE 28.99 IN Hg. HUMIDITY 50 %

FLUE GAS MOLECULAR WT. _____, TEMP. 550 °F, DENSITY _____ g/cc, VISCOSITY _____ POISE

PUMP PRESS. 26.5 "Hg METER TEMP. 91°F

CUP

	Stage Number							Stage Blank
	1	2	3	4	5			
~~Foil~~ + Sample, g	3.3677	3.8063	3.2598	3.6594	3.6679			
Unused Foil, g	3.2477	3.7561	3.2389	3.6530	3.6646			
Sample, g	0.1200	0.0502	0.0109	0.0064	0.0033			
Correction for Blank, g								
Final Sample, g								

FILTER NO.	Sample	Blank
FILTER + SAMPLE, g	.0422	
FILTER TARE, g	.0394	
SAMPLE, g	.0028	
CORRECTION FOR BLANK, g		
FINAL SAMPLE, g		

FULL CONTAINER, g _____

EMPTY CONTAINER, g _____

CYCLONE CATCH, g 0.4328

TABLE 1.

	Symbol	Value
Pressure drop across impactor during test "Hg"	ΔP_2	1.93
Static pressure at inlet to impactor, atm.	P_2	.985
Density of aerosol particle, grams/cc	ρ_p	.64
Density of gas at inlet sampling conditions, grams/cc	ρ_2	6.4×10^{-4}
Molecular weight of sample gas	MW_2	30.1
Molecular weight of calibration gas	MW_1	29
Temperature of gas at sampling conditions, °K	T_2	561
Temperature of gas at calibration conditions, °K	T_1	294
Static pressure under calibration conditions, atm.	P_1	1.0
Gas viscosity at sampling conditions, poises	μ	3.2×10^{-4}
Stage jet diameter, cm	D_{c_2}	.294
	D_{c_3}	.1775
	D_{c_4}	.1396
	D_{c_5}	.0946
	D_{c_6}	.0731
Sample quantity collected on each cup	R_2	.1200 g
	R_3	.0502
	R_4	.0109
	R_5	.0064
	R_6	.0033
	R_7	.0028
Dimension conversion constant	g_c	1

TABLE 2.

	Symbol	Value
Effective pressure drop, "Hg"	ΔP_E	3.602
Inlet flow to impactor, cc/second	F	
Pressure out of stages, atm.	P_{S_2}	.985
	P_{S_3}	.985
	P_{S_4}	.985
	P_{S_5}	.96803
	P_{S_6}	.9205
Density of gas out of the various stages, grams/cc	P_{S_2}	.00064
	P_{S_3}	.00064
	P_{S_4}	.00064
	P_{S_5}	.000629
	P_{S_6}	.000598
Characteristic diameter, microns	D_{pc_2}	4.25012
	D_{pc_3}	2.48489
	D_{pc_4}	1.67938
	D_{pc_5}	0.85143
	D_{pc_6}	0.50535
Criteria for validity of equation 18	$\frac{D_{pc_6} \times 10^{-4}}{L}$	2.97543
Mean free path	L	.0000169841
Average molecular velocity	$\bar{v}$	63,013.86

Continued

TABLE 2 (Continued)

	Symbol	Value	CUM %
% on a cup of the total sample collected	CYCLONE		100
Stage 2	γ_2	61.98	30.91
3	γ_3	25.93	11.75
4	γ_4	5.63	3.74
5	γ_5	3.31	2.00
6	γ_6	1.70	.97
Filter	γ_7	1.45	.44
	Total	100.00*	

*Any discrepancy due to rounding off should be buried in the largest γ cumulative % smaller than D_{pc}

Σ_2	38.02
Σ_3	12.09
Σ_4	6.46
Σ_5	3.15
Σ_6	1.45

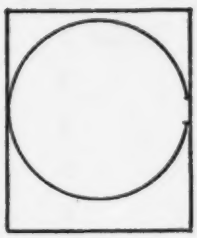
K V B, INC.

STACK DATA

Test No._____
Engr._____

Date 5-6-76 Location 3 Unit No._____ Fuel COKE/GAS
Load_____ K#/hr or MBtu/hr Filter No. 1 BLANK NO. 2
Sample Box No. 1 Meter Box No._____ Probe No. 3 Probe Length 8'

Filter Heater Setting 250
Probe Heater Setting 300
Stack Moisture _____ %
Ambient Temperature 65 °F
Nozzle Diameter .25 in.
Atmospheric Pressure 28.95 in.Hg
Weather CLOUDY
Stack Gas Pressure, Ps -6 iwg
Abs. Stack Press., AP=P$_s$ +407= ____ iwga
Stack Gas Sp. Gravity, Gs ____ n.d.
Stack Area, As 84 ft^2



Remarks
Final Meter: 1023.84
Initial Meter: 1018.26
Δ = 5.58

PROBE >500°F

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
1400	1006.34	2.0	.8	.62	545	130	125	250	92
1500	1018.26	4.5	.8	.62	545	75	180	250	105
1505	1021	4.5	.8	.62	545	60	190	240	105
1510	1023.84	4.5	.8	.62	545	65	180	225	105
Total					°F				
Avg.			0.8		545°F + 460				

Ts= 1005 °R

60-13

11/20/75

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 5/5/76

Location: 3

Unit: _____

Test: VELOCITY TRAVERSE - KILN OUTLET Personnel: _____

Fuel: _____

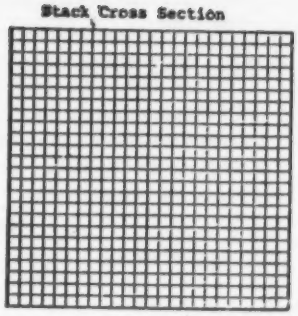
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
0930	1	12'	.3		1640 *	29.0	64.3	
	↓	10'	.2		1640 *	↓	52.5	
		8'4"	.19	1180	1640		51.2	
		7'6"	.18	1140	1600		49.2	
		6'4"	.12	1130	1590		40.0	
	↓	5'4"	.07	920	1380		28.5	
	2	12'	.29		1640 *		63.2	
	↓	10'	.2		1640 *		52.5	
		8'4"	.18	1180	1640		49.8	
		7'6"	.18	1140	1600		49.2	
		6'4"	.12	1130	1590		40.0	
	↓	5'4"	.03	920	1380	↓	18.6	

Ave all points 46.5 ; w/o 5'4" points 56.1

6002-13

* TEMPERATURE ASSUMED - PARTICULATE PROBE WITH T/C WOULD NOT REACH

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 5-6-76 _____

Location: 3 _____

Unit: _____ _____

Test: VELOCITY TRAVERSE Personnel: _____

Fuel: _____ _____

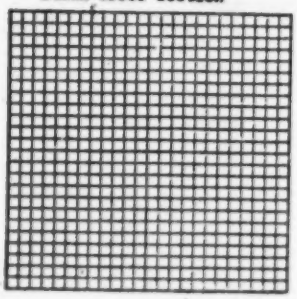
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth BAND	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
	3	1	.41	540	1000	29.0	48.7	
	↓	3	.65	540	1000	↓	61.4	
		4	.8	550	1010		61.2	
		5	.85	555	1015		70.7	
		6	.85	560	1020		70.9	
		7	.9	570	1030		73.3	
	↓	8	.96	575	1035		75.9	
Ave 66.0	4	1	.27	540	1000		39.6	
		2	.43	550	1010		50.16	
		3	.5	540	1000		53.8	
		4	.65	545	1005		61.5	
		5	.87	560	1020		71.7	
		6	.95	570	1030		75.3	
		7	1.1	575	1035		81.2	
	↓	8	1.1	580	1040	↓	81.4	
Ave 64.3								

Ave all points 66.4

6003-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 5-6-76 _____

Location: 3 _____

Unit: _____ _____

Test: VELOCITY TRAVERSE Personnel: _____

Fuel: _____ _____

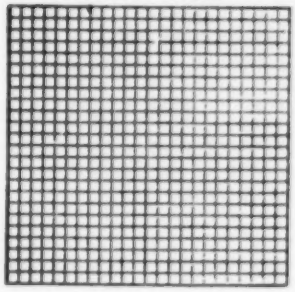
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): 29.92 (P_g)

Pitot Tube Coefficient: 1.0 (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Point Port	~~Duplicate~~ BAND	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
	2	3	.65	540	1000	29.0	61.36	
	↓	4	.67	540	1000	↓	62.3	
		5	.75	545	1005		66.1	
		6	.8	550	1010		68.4	
		7	.8	550	1010		68.4	
	↓	8	1.1	570	1020		80.6	
Ave 67.9	1	3	.73	510	970		64.05	
	↓	4	.8	520	980		67.4	
		5	.78	525	985		66.7	
		6	.77	525	985		66.3	
		7	.83	530	990		69.0	
	↓	8	.85	540	1000	↓	70.2	
Ave 67.3								

6002-13

PETROLEUM REFINERY HEATER DESIGN DATA

Location No. 4 Unit No.

Unit Description

THE HEATER IS A VERTICALLY FIRED NATURAL DRAFT REFINERY HEATER EQUIPPED WITH AN OPTIMIZER SYSTEM.

Installation Date	1970
Heater Rating	86.6 $\times 10^6$ BTU/HR
Burner Description	32 COMBINATION OIL/GAS BURNERS IN
	TWO CELLS OF 16 BURNERS EACH.
Test Fuel Combinations	REFINERY GAS PLUS NATURAL GAS
	REFINERY GAS PLUS PROPANE
	REFINERY GAS PLUS OIL
Fuel Temp. at Burner (°F)	AMBIENT
Primary Air Temp. (°F)	AMBIENT

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 4- Date 5/24/76 Location 4 Engr._____

Unit No._____ Fuel GAS Capacity ?

Unit Type FLASHER/HEATER Burner Type JOHN ZINK

1. Test No.	4-1		4-1		4-1		4-1		4-2	
2. Date	5/24/76		5/24/76		5/24/76		5/24/76		5/24/76	
3. Time	1005		1030		1100		1130		1200	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	4.1		4.1		4.0		3.95		3.9	
9. NOx (hot) read/3% O_2 (ppm)*	70	75	71	76	70	74	69	72	71	75
10. NO (hot) read/3% O_2 (ppm)*	69	74	70	75	70	74	69	72	70	74
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	1	1	0	0	0	0	1	1
12. NO (cold) read/3% O_2 (ppm)*	80	85	81	86	82	87	82	86	85	89
13. Carbon Dioxide (%)	9.7		9.0		10.6		9.9		10.2	
14. Carbon Monoxide (ppm) uncor/cor*	10	11	6	6	5	5	12	13	13	14
15. Hydrocarbon (ppm) uncor/cor*	3		2		1		1		1	
16. Sulfur Dioxide (ppm) uncor/cor*	34		21		24		34		38	
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)					67		67			
19. Dew Point Temp. (°F/°C)							61			
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)							71			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 4- Date 5/24/76 Location 4 Engr._____

Unit No._____ Fuel GAS Capacity_____

Unit Type FLASHER/HEATER Burner Type JOHN ZINK

1. Test No.	4-2		4-2		4-2		4-3		4-3	
2. Date	5/24/76		5/24/76		5/24/76		5/24/76		5/24/76	
3. Time	1230		1300		1330		1400		1430	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	3.8		3.75		3.8		7.0		5.7	
9. NOx (hot) read/3% O_2 (ppm)*	77	81	77	80	75	78	69	89	70	82
10. NO (hot) read/3% O_2 (ppm)*	76	80	76	79	75	78	68	87	69	81
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	1	1	0	0	1	1	1	1
12. NO (cold) read/3% O_2 (ppm)*	87	91	90	94	88	92	79	102	83	98
13. Carbon Dioxide (%)	10.4		9.8		9.9		7.4		9.0	
14. Carbon Monoxide (ppm) uncor/cor*	10	10	10	10	12	13	10	13	6	7
15. Hydrocarbon (ppm) uncor/cor*	0		1		1		2		1	
16. Sulfur Dioxide (ppm) uncor/cor*	34		34		38		34		42	
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

(NOT STEADY)

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 4- Date 5/24/76 Location 4 Engr._____

Unit No._____ Fuel GAS Capacity_____

Unit Type FLASHER / HEATER Burner Type JOHN ZINK

1. Test No.	4-3											
2. Date	5/24/76											
3. Time	1500											
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position												
8. Oxygen (%)	3.8											
9. NOx (hot) read/3% O_2 (ppm)*	70	73										
10. NO (hot) read/3% O_2 (ppm)*	69	72										
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1										
12. NO (cold) read/3% O_2 (ppm)*	81	85										
13. Carbon Dioxide (%)	10.0											
14. Carbon Monoxide (ppm) uncor/cor*	10	10										
15. Hydrocarbon (ppm) uncor/cor*	1											
16. Sulfur Dioxide (ppm) uncor/cor*	46											
17. Smoke Spot (Bacharach)												
18. Atmos. Temp. (°F/°C)												
19. Dew Point Temp. (°F/°C)												
20. Atmos. Pressure (in. Hg)												
21. Relative Humidity (%)												
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 4-4 Date 5/25/76 Location 4 Engr. _____

Unit No. _____ Fuel OIL/GAS Capacity _____

Unit Type FLASHER/HEATER Burner Type _____

1. Test No.	4-4		4-4		4-4		4-4		4-4	
2. Date	5/25/76		5/25/76		5/25/76		5/25/76		5/25/76	
3. Time	0930		1000		1030		1100		1130	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	4.1		4.0		3.8		3.75		3.9	
9. NOx (hot) read/3% O_2 (ppm)*	134	143	138	146	138	144	137	143	136	143
10. NO (hot) read/3% O_2 (ppm)*	131	140	136	144	137	143	136	142	135	142
11. NO_2 (hot) read/3% O_2 (ppm)*	3	3	2	2	1	1	1	1	1	1
12. NO (cold) read/3% O_2 (ppm)*	162	173	162	172	163	171	158	165	157	165
13. Carbon Dioxide (%)	11.7		11.9		12.0		11.7		11.2	
14. Carbon Monoxide (ppm) uncor/cor*	8	9	10	11	10	10	10	10	12	13
15. Hydrocarbon (ppm) uncor/cor*	2		2		2		1		1	
16. Sulfur Dioxide (ppm) uncor/cor*	106		108		118		102		94	
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 4-4/4-5 Date 5/25/76 Location 4 Engr._____

Unit No._____ Fuel OIL/GAS Capacity_____

Unit Type FLASHER/HEATER Burner Type JOHN ZINK

1. Test No.	4-4		4-5		4-5		4-5		4-5	
2. Date	5-25-76		5-25-76		5-25-76		5-25-76		5-25-76	
3. Time	1200		1230		1300		1330		1400	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	4.0		5.0		4.0		4.0		4.0	
9. NOx (hot) read/3% O_2 (ppm)*	136	144	134	151	136	144	135	143	134	142
10. NO (hot) read/3% O_2 (ppm)*	135	143	133	150	135	143	134	142	133	141
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	1	1	1	1	1	1	1	1
12. NO (cold) read/3% O_2 (ppm)*	162	172	157	177	161	171	158	167	153	162
13. Carbon Dioxide (%)	11.5		10.6		11.0		11.9		12.0	
14. Carbon Monoxide (ppm) uncor/cor*	12	13	12	14	12	13	10	11	12	13
15. Hydrocarbon (ppm) uncor/cor*	2		2		2		1		0	
16. Sulfur Dioxide (ppm) uncor/cor*	103		96		106		102		93	
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 4-5 Date 5/25/76 Location 4 Engr._____

Unit No._____ Fuel OIL/GAS Capacity_____

Unit Type FLASHER/HEATER Burner Type JOHN ZINK

1. Test No.	4-5									
2. Date	5-25-76									
3. Time	1430									
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	3.7									
9. NOx (hot) read/3% O_2 (ppm)*	135	140								
10. NO (hot) read/3% O_2 (ppm)*	134	139								
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1								
12. NO (cold) read/3% O_2 (ppm)*	158	164								
13. Carbon Dioxide (%)	12.2									
14. Carbon Monoxide (ppm) uncor/cor*	12	12								
15. Hydrocarbon (ppm) uncor/cor*	1									
16. Sulfur Dioxide (ppm) uncor/cor*	103									
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	76°F									
19. Dew Point Temp. (°F/°C)	64°F									
20. Atmos. Pressure (in. Hg)	29.91									
21. Relative Humidity (%)	53%									
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 4-6/4-7 Date 5/26/76 Location 4 Engr._____

Unit No._____ Fuel OIL/GAS Capacity_____

Unit Type FLASHER/HEATER Burner Type JOHN ZINK

1. Test No.	4-6		4-6		4-7 (A)		4-7 (B)									
2. Date	5/26/76		5/26/76		5/26/76		5/26/76									
3. Time	1030		1100		1200		1235									
4. Load																
5. Process Rate																
6. Flue Diam. or Size, ft																
7. Probe Position																
8. Oxygen (%)	3.8		4.55		5.4		5.4									
9. NOx (hot) read/3% O_2 (ppm)*	92	96	92	101	84	97	80	92								
10. NO (hot) read/3% O_2 (ppm)*	91	95	91	100	83	96	79	91								
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	1	1	1	1	1	1								
12. NO (cold) read/3% O_2 (ppm)*	108	113	107	117	97	112	90	104								
13. Carbon Dioxide (%)	16.5% dil.		15.0% dil.		13.5% dil		13.5% dil									
14. Carbon Monoxide (ppm) uncor/cor*	13	14	13	14	8	9	8	9								
15. Hydrocarbon (ppm) uncor/cor*	0.0.S.		0.0.S.		0.0.S.		0.0.S.									
16. Sulfur Dioxide (ppm) uncor/cor*	0.0.S.		0.0.S.		0.0.S.		0.0.S.									
17. Smoke Spot (Bacharach)																
18. Atmos. Temp. (°F/°C)																
19. Dew Point Temp. (°F/°C)																
20. Atmos. Pressure (in. Hg)																
21. Relative Humidity (%)																
22.					BRNS # 1, 3, 14, & 16 OOS AND AIR REG. OPEN		Closed in Service Brns Air Reg. To 60 Further O/S & Lower O_2.									
23.																
24.																
25.																
26.																
27.																
28.																
29.																
30.																

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date 5-27-76 Location 4 Engr._____

Unit No._____ Fuel N.G. / R.G. + PROPANE Capacity_____

Unit Type FLASHER/HEATER Burner Type JOHN ZINK

1. Test No.	4-8		4-9		4-9		4-9		4-9	
2. Date	5/27/76		5/27/76		5/27/76		5/27/76		5/27/76	
3. Time	0900		1000		1030		1100		1200	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	4.3		4.7		4.65		4.55		5.45	
9. NOx (hot) read/3% O_2 (ppm)* *	63	68	64	71	66	73	71	78	69	80
10. NO (hot) read/3% O_2 (ppm)*	63	68	63	70	65	72	70	77	68	79
11. NO_2 (hot) read/3% O_2 (ppm)*	0	0	1	1	1	1	1	1	1	1
12. NO (cold) read/3% O_2 (ppm)*	95	102	82	91	88	97	83	91	83	96
13. Carbon Dioxide (%)	9.8		9.2		9.5		9.6		9.9	
14. Carbon Monoxide (ppm) uncor/cor*	10	11	8	9	8	9	9	10	8	9
15. Hydrocarbon (ppm) uncor/cor*	0.0.S.		0.0.S.		2		1		1	
16. Sulfur Dioxide (ppm) uncor/cor*	0.0.S.		0.0.S.		18		17		19	
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)										
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

1, 16 E
1, 3, 14 W
1, 16 DOORS WITH AIR REGISTERS CLOSED

BASELINE

2 TO DOORS 4, 7, 10, 13 EAST & WEST DOORS WITH AIR OPEN

SALT

SALT

SALT

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

* LOW FLOW

SALT = Same As Last Test

MOBILE LABORATORY DATA

Test No._____

Test No._____ Date 5/27/76 (PROP., N.G.) Location 4 Engr._____

Unit No._____ Fuel REF. GAS Capacity_____

Unit Type FLASHER/HEATER Burner Type JOHN ZINK

1. Test No.	4-10		4-11		4-11						
2. Date	5/27/76		5/27/76		5/27/76						
3. Time	1300		1330		1430						
4. Load											
5. Process Rate											
6. Flue Diam. or Size, ft											
7. Probe Position											
8. Oxygen (%)	5.1		5.1		5.0						
9. NOx (hot) read/3% O_2 (ppm)*	77	87	79	89	80	90					
10. NO (hot) read/3% O_2 (ppm)*	76	86	78	88	80	90					
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	1	1	0	0					
12. NO (cold) read/3% O_2 (ppm)*	90	102	93	105	95	107					
13. Carbon Dioxide (%)	9.6		10.2		9.9						
14. Carbon Monoxide (ppm) uncor/cor*	10	11	10	11	12	14					
15. Hydrocarbon (ppm) uncor/cor*	2		2		2						
16. Sulfur Dioxide (ppm) uncor/cor*	21		23		23						
17. Smoke Spot (Bacharach)											
18. Atmos. Temp. (°F/°C)											
19. Dew Point Temp. (°F/°C)											
20. Atmos. Pressure (in. Hg)											
21. Relative Humidity (%)											
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

BURNERS 4, 8, 9, 13 OUT OF SERVICE

BURNERS 11, 61, 71, 61 OUT OF SERVICE

SALT

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date_____ Location 4 Engr._____

Unit No._____ Fuel_____ Capacity_____

Unit Type_____ Burner Type_____

1. Test No.	4-12					
2. Date	5-28-76					
3. Time	0900					
4. Load						
5. Process Rate						
6. Flue Diam. or Size, ft						
7. Probe Position						
8. Oxygen (%)	5.3					
9. NOx (hot) read/3% O_2 (ppm)*	102	117				
10. NO (hot) read/3% O_2 (ppm)*	101	116				
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1				
12. NO (cold) read/3% O_2 (ppm)*	120	138				
13. Carbon Dioxide (%)	10.2					
14. Carbon Monoxide (ppm) uncor/cor*	10	11				
15. Hydrocarbon (ppm) uncor/cor*	0					
16. Sulfur Dioxide (ppm) uncor/cor*	42	48				
17. Smoke Spot (Bacharach)						
18. Atmos. Temp. (°F/°C)						
19. Dew Point Temp. (°F/°C)						
20. Atmos. Pressure (in. Hg)						
21. Relative Humidity (%)						
22.						
23.						
24.						
25.						
26.						
27.						
28.						
29.						
30.						

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

KVB

Location 4

Control Room Data Sheet

FUEL S.G. = ~~1.08~~ 0.68 AT CONTROL ROOM. READ 0-100 SCALE .68 AT BOILER ROOM

Date MAY 24, 1976

Test No. 4-1

Parameter	Meter No.	Units	Reading
Time			10:00
Fuel gas flow X .31608	FR 156	MMSCFD	6.29
Fuel gas pressure	PI 191	psig	51
SR Resid. Surge Drum	LRC-103	%	65
Total flow to #33, 34 X 8670	FR ~~LR 882~~ 128	X B/D	5.3
SR Residue	FR-123	Bbl/day	—
X 1500	FR-102	Bbl/day	3.0
?	FR-128	Bbl/day	
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
" - Pass B	FRC-130	Bbl/day	7.9
X 800 - Pass C	FRC-131	Bbl/day	7.9
" - Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	750
SR Resid out 33 West	TRC-150	°F	750
Firebox pressure	PR-153	" H_2O	0.015
Damper position	OPTR-152	% Open	60
Hand indicating controller-East	HIC-149	No Units	005
Hand indicating controller-West	HIC-150	No Units	005
Oxygen in stack	AR-151	%	5.3
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	790
Pass A - Mid	-2	°F	810
" B "	-3	°F	830
" C "	-4	°F	830
" D "	-5	°F	825
" A Out	-6	°F	970
" B "	-7	°F	—
" C "	-8	°F	1060
" D "	-9	°F	~~1000~~ 995
" A Inner	-10	°F	805

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-1

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	540
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1200
" " " " SE end	.26	°F	1280
Temp. radiant section - NE	.27	°F	1245
- SE	.28	°F	1359
Temp. heater 33 stack	.29	°F	527
Temp. below conv. - NW	.31	°F	1208
" " " SW	.32	°F	1281
Temp. of radiant section - NW	.33	°F	1293
" " " " SW	.34	°F	1371
Temp. pass C rad. sec. skin	.42	°F	835
" " B " " "	.47	°F	437
" " D " " "	.48	°F	829
Temp. conv. - rad. crossover Pass A	.49	°F	600
" " " " " B	.50	°F	607
Temp. combined outlet A & B	.51	°F	750
Temp. conv. - Rad. crossover Pass C	.52	°F	607
" " " " " D	.53	°F	601
Temp. combined outlet C & D	.54	°F	752
Draft gages			
Heater stack - above damper		" H_2O	-.84
- below damper		" H_2O	-.035
Heater roof tubes (East cell)		" H_2O	+.015
(West cell)		" H_2O	+.02
Heater firebox (West)		" H_2O	-.065
(East)		" H_2O	-.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date MAY 24, 1976 S.G. .68

Test No. 4-1 Page 1

Parameter	Meter No.	Units	Reading
Time			10:30
Fuel gas flow X .31608	FR 156	MMSCFD	6.35
Fuel gas pressure	PI 191	psig	50
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34 X 8670	~~LR-882~~ FR128	X B/D	5.2 45084
SR Residue X 5800	FR-123	Bbl/day	7.3 42340
X 1500	FR-102	Bbl/day	2.1 3150
	FR-128	Bbl/day	— 45490
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.85
- Pass B	FRC-130	Bbl/day	7.95
- Pass C	FRC-131	Bbl/day	7.85
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	~~25~~ 750
SR Resid out 33 West	TRC-150	°F	751
Firebox pressure	PR-153	" H_2O	-.015 -.02
Damper position	OPTR-152	% Open	60
Hand indicating controller-East	HIC-149	No Units	005
Hand indicating controller-West	HIC-150	No Units	004
Oxygen in stack	AR-151	%	5.4
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	790
Pass A - Mid	-2	°F	810
" B "	-3	°F	830
" C "	-4	°F	830
" D "	-5	°F	825
" A Out	-6	°F	970
" B "	-7	°F	—
" C "	-8	°F	1060
" D "	-9	°F	995
" A Inner	-10	°F	805

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-1

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	540
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1199
" " " " SE end	.26	°F	1280
Temp. radiant section - NE	.27	°F	1260
- SE	.28	°F	1352
Temp. heater 33 stack	.29	°F	526
Temp. below conv. - NW	.31	°F	1210
" " " SW	.32	°F	1279
Temp. of radiant section - NW	.33	°F	1294
" " " " SW	.34	°F	1369
Temp. pass C rad. sec. skin	.42	°F	835
" " B " " "	.47	°F	437
" " D " " "	.48	°F	828
Temp. conv. - rad. crossover Pass A	.49	°F	598
" " " " " B	.50	°F	605
Temp. combined outlet A & B	.51	°F	749
Temp. conv. - Rad. crossover Pass C	.52	°F	606
" " " " " D	.53	°F	600
Temp. combined outlet C & D	.54	°F	750
Draft gages			
Heater stack - above damper		" H_2O	-.97
- below damper		" H_2O	-.05
Heater roof tubes (East cell)		" H_2O	+.02
(West cell)		" H_2O	+.02
Heater firebox (West)		" H_2O	-.07
(East)		" H_2O	-.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-24-76

Test No. 4-1

Parameter	Meter No.	Units	Reading
Time			11:05
Fuel gas flow	FR 156	MMSCFD	6.4
Fuel gas pressure	PI 191	psig	49
SR Resid. Surge Drum	LRC-103	%	62
Total flow to #33, 34 FR 128	LR 982	✗	5.2
SR Residue	FR-123	Bbl/day	7.6
	FR-102	Bbl/day	2.0
	FR-128	Bbl/day	—
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.85
X 800 - Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	750
SR Resid out 33 West	TRC-150	°F	760
Firebox pressure	PR-153	" H_2O	-.012
Damper position	OPTR-152	% Open	58
Hand indicating controller-East	HIC-149	No Units	009
Hand indicating controller-West	HIC-150	No Units	009
Oxygen in stack	AR-151	%	5.5
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	810
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	950
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	960
" A Inner	-10	°F	800

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-1

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	
SR residue feed to 33 & 34	-1	°F	730
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1203
" " " " SE end	.26	°F	1281
Temp. radiant section - NE	.27	°F	1254
- SE	.28	°F	1360
Temp. heater 33 stack	.29	°F	529
Temp. below conv. - NW	.31	°F	1207
" " " SW	.32	°F	1281
Temp. of radiant section - NW	.33	°F	1302
" " " " SW	.34	°F	1358
Temp, pass C rad. sec. skin	.42	°F	835
" " B " " "	.47	°F	436
" " D " " "	.48	°F	827
Temp. conv. - rad. crossover Pass A	.49	°F	598
" " " " " B	.50	°F	605
Temp. combined outlet A & B	.51	°F	757
Temp. conv. - Rad. crossover Pass C	.52	°F	605
" " " " " D	.53	°F	599
Temp. combined outlet C & D	.54	°F	751
Draft gages			
Heater stack - above damper		" H_2O	≈ -1.0
- below damper		" H_2O	-0.03
Heater roof tubes (East cell)		" H_2O	+0.02
(West cell)		" H_2O	+0.03
Heater firebox (West)		" H_2O	-0.05
(East)		" H_2O	-0.06

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-24-76

Test No. 4-1

S. G. = 0.68

Parameter	Meter No.	Units	Reading
Time			11:30
Fuel gas flow	FR 156	MMSCFD	6.4
Fuel gas pressure	PI 191	psig	50
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	~~LR-882~~	%	—
SR Residue	FR-123	Bbl/day	7.3
	FR-102	Bbl/day	2.2
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.8
x 800 - Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	750
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	.06
Damper position	OPTR-152	% Open	59
Hand indicating controller-East	HIC-149	No Units	009
Hand indicating controller-West	HIC-150	No Units	009
Oxygen in stack	AR-151	%	5.5
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	820
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	950
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	980
" A Inner	-10	°F	800

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-1

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	740
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1202
" " " " SE end	.26	°F	1283
Temp. radiant section - NE	.27	°F	1259
- SE	.28	°F	1361
Temp. heater 33 stack	.29	°F	527
Temp. below conv. - NW	.31	°F	1209
" " " SW	.32	°F	1283
Temp. of radiant section - NW	.33	°F	1297
" " " " SW	.34	°F	1371
Temp, pass C rad. sec. skin	.42	°F	839
" " B " " "	.47	°F	438
" " D " " "	.48	°F	828
Temp. conv. - rad. crossover Pass A	.49	°F	597
" " " " " B	.50	°F	605
Temp. combined outlet A & B	.51	°F	751
Temp. conv. - Rad. crossover Pass C	.52	°F	605
" " " " " D	.53	°F	598
Temp. combined outlet C & D	.54	°F	751
Draft gages			
Heater stack - above damper		" H_2O	~ -1.1
- below damper		" H_2O	- .02
Heater roof tubes (East cell)		" H_2O	+ .02
(West cell)		" H_2O	+ .025
Heater firebox (West)		" H_2O	-.07
(East)		" H_2O	-.05

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-24-76 S.G. .76

Test No. 4-2

Parameter	Meter No.	Units	Reading
Time			12:00
Fuel gas flow	FR 156	MMSCFD	6.1
Fuel gas pressure HEADER	PI 191	psig	52
SR Resid. Surge Drum	LRC-103	%	
Total flow to #33, 34	LR 882	%	—
SR Residue	FR-123	Bbl/day	7.3
	FR-102	Bbl/day	2.1
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.85
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	752
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-.055
Damper position	OPTR-152	% Open	58
Hand indicating controller-East	HIC-149	No Units	8
Hand indicating controller-West	HIC-150	No Units	8.2
Oxygen in stack	AR-151	%	5.2
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	810
" B "	-3	°F	830
" C "	-4	°F	830
" D "	-5	°F	830
" A Out	-6	°F	960
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	1000
" A Inner	-10	°F	810

Control Room Data Sheet

Test No. 4-2

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	560
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1204
" " " " SE end	.26	°F	1290
Temp. radiant section - NE	.27	°F	1275
- SE	.28	°F	1365
Temp. heater 33 stack	.29	°F	525
Temp. below conv. - NW	.31	°F	1211
" " " SW	.32	°F	1253
Temp. of radiant section - NW	.33	°F	1312
" " " " SW	.34	°F	1369
Temp. pass C rad. sec. skin	.42	°F	847
" " B " " "	.47	°F	441
" " D " " "	.48	°F	829
Temp. conv. - rad. crossover Pass A	.49	°F	597
" " " " " B	.50	°F	606
Temp. combined outlet A & B	.51	°F	753
Temp. conv. - Rad. crossover Pass C	.52	°F	606
" " " " " D	.53	°F	599
Temp. combined outlet C & D	.54	°F	752
Draft gages			
Heater stack - above damper		" H_2O	-1.0
- below damper		" H_2O	-0.02
Heater roof tubes (East cell)		" H_2O	+0.02
(West cell)		" H_2O	+0.02
Heater firebox (West)		" H_2O	-0.05
(East)		" H_2O	-0.05

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-24-76

Test No. 4-2

Parameter	Meter No.	Units	Reading
Time			12:30
Fuel gas flow	FR 156	MMSCFD	5.9
Fuel gas pressure	PI 191/PI98	psig	40.52
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	LR 982	%	—
SR Residue	FR-123	Bbl/day	7.3
	FR-102	Bbl/day	2.3
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	752
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-.05
Damper position	OPTR-152	% Open	59
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	4.8
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	810
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	960
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	1000
" A Inner	-10	°F	810

Control Room Data Sheet

Test No. 4-2

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1199
" " " " SE end	.26	°F	1290
Temp. radiant section - NE	.27	°F	1284
- SE	.28	°F	1354
Temp. heater 33 stack	.29	°F	526
Temp. below conv. - NW	.31	°F	1209
" " " SW	.32	°F	1285
Temp. of radiant section - NW	.33	°F	1324
" " " " SW	.34	°F	1371
Temp. pass C rad. sec. skin	.42	°F	843
" " B " " "	.47	°F	440
" " D " " "	.48	°F	831
Temp. conv. - rad. crossover Pass A	.49	°F	598
" " " " " B	.50	°F	606
Temp. combined outlet A & B	.51	°F	752
Temp. conv. - Rad. crossover Pass C	.52	°F	605
" " " " " D	.53	°F	599
Temp. combined outlet C & D	.54	°F	751
Draft gages			
Heater stack - above damper		" H_2O	> -1.0
- below damper		" H_2O	-.03
Heater roof tubes (East cell)		" H_2O	+.02
(West cell)		" H_2O	+.02
Heater firebox (West)		" H_2O	-.06
(East)		" H_2O	-.06

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-24-76

Test No. 4-2

S.G. = .79

Page 1

Parameter	Meter No.	Units	Reading
Time			13:03
Fuel gas flow	FR 156	MMSCFD	6.1
Fuel gas pressure	PI 191/98	psig	37.5/60
SR Resid. Surge Drum	LRC-103	%	—
Total flow to #33, 34	LR 882	%	47
SR Residue	FR-123	Bbl/day	7.4
	FR-102	Bbl/day	2.2
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	751
SR Resid out 33 West	TRC-150	°F	757
Firebox pressure	PR-153	" H_2O	-.08
Damper position	OPTR-152	% Open	59
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	4.7
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	810
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	980
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	1000
" A Inner	-10	°F	800

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-2

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1200
" " " " SE end	.26	°F	1291
Temp. radiant section - NE	.27	°F	1289
- SE	.28	°F	1342
Temp. heater 33 stack	.29	°F	523
Temp. below conv. - NW	.31	°F	1208
" " " SW	.32	°F	1283
Temp. of radiant section - NW	.33	°F	1317
" " " " SW	.34	°F	1317
Temp. pass C rad. sec. skin	.42	°F	839
" " B " " "	.47	°F	438
" " D " " "	.48	°F	828
Temp. conv. - rad. crossover Pass A	.49	°F	598
" " " " " B	.50	°F	605
Temp. combined outlet A & B	.51	°F	752
Temp. conv. - Rad. crossover Pass C	.52	°F	605
" " " " " D	.53	°F	598
Temp. combined outlet C & D	.54	°F	751
Draft gages			
Heater stack - above damper		" H_2O	-1.03
- below damper		" H_2O	-0.02
Heater roof tubes (East cell)		" H_2O	+0.02
(West cell)		" H_2O	+0.02
Heater firebox (West)		" H_2O	-0.06
(East)		" H_2O	-0.06

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-24-76 S.G. .78

Test No. 4-2

Parameter	Meter No.	Units	Reading
Time			13:31
Fuel gas flow	FR 156	MMSCFD	6.0
Fuel gas pressure	PI 191/98	psig	39 / 52
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	LR 882	—	—
SR Residue	FR-123	Bbl/day	7.3
	FR-102	Bbl/day	2.2
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.8
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	752
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-.04
Damper position	OPTR-152	% Open	60
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	4.9
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	810
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	980
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	1000
" A Inner	-10	°F	810

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-2

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1198
" " " " SE end	.26	°F	1290
Temp. radiant section - NE	.27	°F	1285
- SE	.28	°F	1358
Temp. heater 33 stack	.29	°F	523
Temp. below conv. - NW	.31	°F	1206
" " " SW	.32	°F	1284
Temp. of radiant section - NW	.33	°F	1324
" " " " SW	.34	°F	1380
Temp. pass C rad. sec. skin	.42	°F	839
" " B " " "	.47	°F	440
" " D " " "	.48	°F	830
Temp. conv. - rad. crossover Pass A	.49	°F	598
" " " " " B	.50	°F	605
Temp. combined outlet A & B	.51	°F	752
Temp. conv. - Rad. crossover Pass C	.52	°F	605
" " " " " D	.53	°F	598
Temp. combined outlet C & D	.54	°F	751
Draft gages			
Heater stack - above damper		" H_2O	>-1.0
- below damper		" H_2O	-.015
Heater roof tubes (East cell)		" H_2O	+.02
(West cell)		" H_2O	+.02
Heater firebox (West)		" H_2O	-.05
(East)		" H_2O	-.06

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-24-76

Test No. 4-3

S.G. = .68

Parameter	Meter No.	Units	Reading
Time			14:00
Fuel gas flow	FR 156	MMSCFD	6.2
Fuel gas pressure	PI 191/98	psig	40 155
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	LR 982	%	—
SR Residue	FR-123	Bbl/day	7.3
	FR-102	Bbl/day	2.2
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	751
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-.052
Damper position	OPTR-152	% Open	54
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	4.5
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	810
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	970
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	1000
" A Inner	-10	°F	810

Control Room Data Sheet

Test No. 4-3

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1199
" " " " SE end	.26	°F	1287
Temp. radiant section - NE	.27	°F	1277
- SE	.28	°F	1333
Temp. heater 33 stack	.29	°F	541
Temp. below conv. - NW	.31	°F	1220
" " " SW	.32	°F	1286
Temp. of radiant section - NW	.33	°F	1311
" " " " SW	.34	°F	1366
Temp. pass C rad. sec. skin	.42	°F	843
" " B " " "	.47	°F	439
" " D " " "	.48	°F	831
Temp. conv. - rad. crossover Pass A	.49	°F	599
" " " " " B	.50	°F	608
Temp. combined outlet A & B	.51	°F	750
Temp. conv. - Rad. crossover Pass C	.52	°F	608
" " " " " D	.53	°F	602
Temp. combined outlet C & D	.54	°F	751
Draft gages			
Heater stack - above damper		" H_2O	-1.05
- below damper		" H_2O	-0.19
Heater roof tubes (East cell)		" H_2O	-0.05
(West cell)		" H_2O	-0.04
Heater firebox (West)		" H_2O	-0.13
(East)		" H_2O	-0.12

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-24-76

Test No. 4-3

S.G. = .69

Parameter	Meter No.	Units	Reading
Time			14:38
Fuel gas flow	FR 156	MMSCFD	6.5
Fuel gas pressure	PI 191/198	psig	40 / 52
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 882	%	—
SR Residue	FR-123	Bbl/day	7.3
	FR-102	Bbl/day	2.2
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	751
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-.022
Damper position	OPTR-152	% Open	56
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	7.5
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	820
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	980
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	1000
" A Inner	-10	°F	810

Control Room Data Sheet

Test No. 4-3

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	735
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1197
" " " " SE end	.26	°F	1287
Temp. radiant section - NE	.27	°F	1284
- SE	.28	°F	1348
Temp. heater 33 stack	.29	°F	532
Temp. below conv. - NW	.31	°F	1216
" " " SW	.32	°F	1283
Temp. of radiant section - NW	.33	°F	1294
" " " " SW	.34	°F	1378
Temp. pass C rad. sec. skin	.42	°F	834
" " B " " "	.47	°F	438
" " D " " "	.48	°F	830
Temp. conv. - rad. crossover Pass A	.49	°F	598
" " " " " B	.50	°F	606
Temp. combined outlet A & B	.51	°F	751
Temp. conv. - Rad. crossover Pass C	.52	°F	605
" " " " " D	.53	°F	599
Temp. combined outlet C & D	.54	°F	751
Draft gages			
Heater stack - above damper		" H_2O	> -1.0
- below damper		" H_2O	-.01
Heater roof tubes (East cell)		" H_2O	+.02
(West cell)		" H_2O	+.035
Heater firebox (West)		" H_2O	-.05
(East)		" H_2O	-.06

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

S.G. = .68

Date 5-24-76

Test No. 4-3

Parameter	Meter No.	Units	Reading
Time			15:02
Fuel gas flow	FR 156	MMSCFD	
Fuel gas pressure	PI 191/98	psig	38/52
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	LR 882	%	—
SR Residue	FR-123	Bbl/day	7.3
	FR-102	Bbl/day	2.0
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	750
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-.015
Damper position	OPTR-152	% Open	58
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	6.6
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	810
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	980
" B "	-7	°F	—
" C "	-8	°F	1100
" D "	-9	°F	1000
" A Inner	-10	°F	810

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-3

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	735
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1197
" " " " SE end	.26	°F	1286
Temp. radiant section - NE	.27	°F	1272
- SE	.28	°F	1354
Temp. heater 33 stack	.29	°F	523
Temp. below conv. - NW	.31	°F	[illegible]0
" " " SW	.32	°F	[illegible]2
Temp. of radiant section - NW	.33	°F	[illegible]3
" " " " SW	.34	°F	[illegible]0
Temp. pass C rad. sec. skin	.42	°F	834
" " B " " "	.47	°F	440
" " D " " "	.48	°F	828
Temp. conv. - rad. crossover Pass A	.49	°F	598
" " " " " B	.50	°F	604
Temp. combined outlet A & B	.51	°F	751
Temp. conv. - Rad. crossover Pass C	.52	°F	604
" " " " " D	.53	°F	598
Temp. combined outlet C & D	.54	°F	751
Draft gages			
Heater stack - above damper		" H_2O	-1.04
- below damper		" H_2O	-0.02
Heater roof tubes (East cell)		" H_2O	+0.02
(West cell)		" H_2O	+0.02
Heater firebox (West)		" H_2O	-0.01
(East)		" H_2O	-0.0[illegible]

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-25-76

S. G. = 0.705

Test No. 4-4 (OIL + GAS)

Parameter	Meter No.	Units	Reading
Time			09:27
Fuel gas flow	FR 156	MMSCFD	3.8
Fuel gas pressure	PI 191/198	psig	39/53
SR Resid. Surge Drum	LRC-103	%	62
Total flow to #33, 34	LR 382	%	—
SR Residue	FR-123	Bbl/day	68
	FR-102	Bbl/day	3.3
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.8
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	755
Firebox pressure	PR-153	" H_2O	-.016
Damper position	OPTR-152	% Open	58
Hand indicating controller-East	HIC-149	No Units	11.6
Hand indicating controller-West	HIC-150	No Units	11.6
Oxygen in stack	AR-151	%	4.7
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	820
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	1020
" B "	-7	°F	—
" C "	-8	°F	1120
" D "	-9	°F	980
" A Inner	-10	°F	810
FUEL OIL TO HEATERS	PI-155	(psig)	70

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-4

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	745
" C " "	-4	°F	750
" D " "	-5	°F	735
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1253
" " " " SE end	.26	°F	1273
Temp. radiant section - NE	.27	°F	1268
- SE	.28	°F	1306
Temp. heater 33 stack	.29	°F	531
Temp. below conv. - NW	.31	°F	1179
" " " SW	.32	°F	1279
Temp. of radiant section - NW	.33	°F	1253
" " " " SW	.34	°F	1329
Temp. pass C rad. sec. skin	.42	°F	841
" " B " " "	.47	°F	436
" " D " " "	.48	°F	820
Temp. conv. - rad. crossover Pass A	.49	°F	595
" " " " " B	.50	°F	602
Temp. combined outlet A & B	.51	°F	752
Temp. conv. - Rad. crossover Pass C	.52	°F	601
" " " " " D	.53	°F	595
Temp. combined outlet C & D	.54	°F	747
Draft gages			
Heater stack - above damper		" H_2O	-1.06
- below damper		" H_2O	-.06
Heater roof tubes (East cell)		" H_2O	+.01
(West cell)		" H_2O	+.01
Heater firebox (West)		" H_2O	-.07
(East)		" H_2O	-.07

BURNERS ON OIL ARE

92 EAST 13 10 8 7 6
WEST 14 11 9 8 5

(1+16 OUT OF SERV.)

SOUTH ←

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5-25-76

Test No. 4-4

S.G. ≃ 0.70

Parameter	Meter No.	Units	Reading
Time			09:58
Fuel gas flow	FR 156	MMSCFD	3.9
Fuel gas pressure	PI 191/198	psig	38/52
SR Resid. Surge Drum	LRC-103	%	61
Total flow to #33, 34	LR 882	%	45
SR Residue	FR-123	Bbl/day	6.9
	FR-102	Bbl/day	3.4
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.8
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.85
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	757
Firebox pressure	PR-153	" H_2O	-0.022
Damper position	OPTR-152	% Open	56
Hand indicating controller-East	HIC-149	No Units	10.6
Hand indicating controller-West	HIC-150	No Units	11.6
Oxygen in stack	AR-151	%	INSTR. BEING WORKED ON 5.1 ?
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	810
" B "	-3	°F	850
" C "	-4	°F	950
" D "	-5	°F	950
" A Out	-6	°F	1000
" B "	-7	°F	—
" C "	-8	°F	1120
" D "	-9	°F	980
" A Inner	-10	°F	810

FUEL OIL TO HEATER

68

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Control Room Data Sheet

Test No. 4-4

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	740
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1256
" " " " SE end	.26	°F	1272
Temp. radiant section - NE	.27	°F	1265
- SE	.28	°F	1303
Temp. heater 33 stack	.29	°F	531
Temp. below conv. - NW	.31	°F	1178
" " " SW	.32	°F	1276
Temp. of radiant section - NW	.33	°F	1243
" " " " SW	.34	°F	1325
Temp. pass C rad. sec. skin	.42	°F	839
" " B " " "	.47	°F	440
" " D " " "	.48	°F	821
Temp. conv. - rad. crossover Pass A	.49	°F	595
" " " " " B	.50	°F	601
Temp. combined outlet A & B	.51	°F	754
Temp. conv. - Rad. crossover Pass C	.52	°F	601
" " " " " D	.53	°F	595
Temp. combined outlet C & D	.54	°F	747
Draft gages			
Heater stack - above damper		" H_2O	-1.06
- below damper		" H_2O	-0.06
Heater roof tubes (East cell)		" H_2O	+0.01
(West cell)		" H_2O	+0.01
Heater firebox (West)		" H_2O	-0.07
(East)		" H_2O	-0.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

S.G. = 0.070

Date 5/25/76

Test No. 4-4

Parameter	Meter No.	Units	Reading
Time			10:34
Fuel gas flow	FR 156	MMSCFD	3.8
Fuel gas pressure	PI 191	psig	39/52
SR Resid. Surge Drum	LRC-103	%	62
Total flow to #33, 34	LR 882	%	46
SR Residue	FR-123	Bbl/day	7.0
	FR-102	Bbl/day	3.4
●	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.85
- Pass B	FRC-130	Bbl/day	7.9 ×
- Pass C	FRC-131	Bbl/day	7.85
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	754
Firebox pressure	PR-153	" H_2O	-.02
Damper position	OPTR-152	% Open	58
Hand indicating controller-East	HIC-149	No Units	10.8
Hand indicating controller-West	HIC-150	No Units	11.6
Oxygen in stack	AR-151	%	4.5 - 5.0
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	790
Pass A - Mid	-2	°F	820
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	1010
" B "	-7	°F	—
" C "	-8	°F	1120
" D "	-9	°F	980
" A Inner	-10	°F	800

FUEL OIL TO HEATER 70

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Control Room Data Sheet

Test No. 4-4

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	745
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1248
" " " " SE end	.26	°F	1269
Temp. radiant section - NE	.27	°F	1258
- SE	.28	°F	1313
Temp. heater 33 stack	.29	°F	527
Temp. below conv. - NW	.31	°F	1175
" " " SW	.32	°F	1275
Temp. of radiant section - NW	.33	°F	1253
" " " " SW	.34	°F	1314
Temp. pass C rad. sec. skin	.42	°F	841
" " B " " "	.47	°F	440
" " D " " "	.48	°F	823
Temp. conv. - rad. crossover Pass A	.49	°F	594
" " " " " B	.50	°F	601
Temp. combined outlet A & B	.51	°F	753
Temp. conv. - Rad. crossover Pass C	.52	°F	601
" " " " " D	.53	°F	595
Temp. combined outlet C & D	.54	°F	746
Draft gages			
Heater stack - above damper		" H_2O	-1.05
- below damper		" H_2O	-.05
Hoater roof tubes (East cell)		" H_2O	+.02
(West cell)		" H_2O	+.01
Heator firebox (West)		" H_2O	-.07
(East)		" H_2O	-.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/25/76

Test No. 4-4

S.G. = 0.070

Parameter	Meter No.	Units	Reading
Time			11:02
Fuel gas flow	FR 156	MMSCFD	4.1
Fuel gas pressure	PI 191	psig	38/53
SR Resid. Surge Drum	LRC-103	%	62
Total flow to #33, 34	LR 382	%	45
SR Residue	FR-123	Bbl/day	7.1
	FR-102	Bbl/day	2.8
	FR-128	Bbl/day	5.1
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.8
- Pass C	FRC-131	Bbl/day	7.85
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	752
SR Resid out 33 West	TRC-150	°F	757
Firebox pressure	PR-153	" H_2O	-.016
Damper position	OPTR-152	% Open	57
Hand indicating controller-East	HIC-149	No Units	10.7
Hand indicating controller-West	HIC-150	No Units	11.8
Oxygen in stack	AR-151	%	4.5
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	790
Pass A - Mid	-2	°F	820
" B "	-3	°F	860
" C "	-4	°F	860
" D "	-5	°F	860
" A Out	-6	°F	1010
" B "	-7	°F	—
" C "	-8	°F	1120
" D "	-9	°F	990
" A Inner	-10	°F	820

FUEL OIL TO HEATER 68

Control Room Data Sheet

Test No. 4-4

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	740
" D " "	-5	°F	740
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1252
" " " " SE end	.26	°F	1272
Temp. radiant section - NE	.27	°F	1265
- SE	.28	°F	1345
Temp. heater 33 stack	.29	°F	527
Temp. below conv. - NW	.31	°F	1175
" " " SW	.32	°F	1279
Temp. of radiant section - NW	.33	°F	1249
" " " " SW	.34	°F	1306
Temp. pass C rad. sec. skin	.42	°F	840
" " B " " "	.47	°F	443
" " D " " "	.48	°F	821
Temp. conv. - rad. crossover Pass A	.49	°F	595
" " " " " B	.50	°F	602
Temp. combined outlet A & B	.51	°F	754
Temp. conv. - Rad. crossover Pass C	.52	°F	602
" " " " " D	.53	°F	595
Temp. combined outlet C & D	.54	°F	746
Draft gages			
Heater stack - above damper		" H_2O	-1.05
- below damper		" H_2O	-.05
Heater roof tubes (East cell)		" H_2O	+.02
(West cell)		" H_2O	+.01
Heater firebox (West)		" H_2O	-.07
(East)		" H_2O	-.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/25/76

S.G. ≃ 0.07

Test No. 4-4

Parameter	Meter No.	Units	Reading
Time			11:32
Fuel gas flow (× 0.316081)	FR 156	MMSCFD	3.9 (1.23)
Fuel gas pressure	PI 191	psig	38 / 53
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	LR 882	%	43
SR Residue	FR-123	Bbl/day	7.0
	FR-102	Bbl/day	3.0
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	752
SR Resid out 33 West	TRC-150	°F	755
Firebox pressure	PR-153	" H_2O	-0.006
Damper position	OPTR-152	% Open	58
Hand indicating controller-East	HIC-149	No Units	10.7
Hand indicating controller-West	HIC-150	No Units	11.6
Oxygen in stack	AR-151	%	5.0
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	820
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	1000
" B "	-7	°F	—
" C "	-8	°F	1150
" D "	-9	°F	1000
" A Inner	-10	°F	810

FUEL OIL TO HEATER

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-4

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	760
" D " "	-5	°F	740
Temperature indicating panel console	TI-230	°F	——
Temp. below conv. section - NE end	230.25	°F	1252
" " " " SE end	.26	°F	1272
Temp. radiant section - NE	.27	°F	1259
- SE	.28	°F	1308
Temp. heater 33 stack	.29	°F	526
Temp. below conv. - NW	.31	°F	1180
" " " SW	.32	°F	1273
Temp. of radiant section - NW	.33	°F	1262
" " " " SW	.34	°F	1337
Temp. pass C rad. sec. skin	.42	°F	844
" " B " " "	.47	°F	442
" " D " " "	.48	°F	826
Temp. conv. - rad. crossover Pass A	.49	°F	596
" " " " " B	.50	°F	603
Temp. combined outlet A & B	.51	°F	754
Temp. conv. - Rad. crossover Pass C	.52	°F	603
" " " " " D	.53	°F	596
Temp. combined outlet C & D	.54	°F	752
Draft gages			
Heater stack - above damper		" H_2O	-1.04
- below damper		" H_2O	-0.06
Heater roof tubes (East cell)		" H_2O	0.00
(West cell)		" H_2O	+0.01
Heater firebox (West)		" H_2O	-0.07
(East)		" H_2O	-0.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/25/76

S.G. ≃ 0.71

Test No. 4-5

Page 1

Parameter	Meter No.	Units	Reading
Time			12:27
Fuel gas flow	FR 156	MMSCFD	4.2
Fuel gas pressure	PI 191	psig	39/53
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	LR 982	%	44
SR Residue	FR-123	Bbl/day	7.0
	FR-102	Bbl/day	2.9
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	757
Firebox pressure	PR-153	" H_2O	-0.036
Damper position	OPTR-152	% ~~Open~~ CL	55 *
Hand indicating controller-East	HIC-149	No Units	10.7
Hand indicating controller-West	HIC-150	No Units	11.6
Oxygen in stack	AR-151	%	6.1 *
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	780
Pass A - Mid	-2	°F	820
" B "	-3	°F	820
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	1000
" B "	-7	°F	—
" C "	-8	°F	1150
" D "	-9	°F	980
" A Inner	-10	°F	820

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* CONDITIONS CHANGING 101

Control Room Data Sheet

Test No. 4-5

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	735
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1248
" " " " SE end	.26	°F	1272
Temp. radiant section - NE	.27	°F	1263
- SE	.28	°F	1310
Temp. heater 33 stack	.29	°F	534
Temp. below conv. - NW	.31	°F	1181
" " " SW	.32	°F	1281
Temp. of radiant section - NW	.33	°F	1254
" " " " SW	.34	°F	1324
Temp. pass C rad. sec. skin	.42	°F	845
" " B " " "	.47	°F	445
" " D " " "	.48	°F	822
Temp. conv. - rad. crossover Pass A	.49	°F	596
" " " " " B	.50	°F	604
Temp. combined outlet A & B	.51	°F	753
Temp. conv. - Rad. crossover Pass C	.52	°F	604
" " " " " D	.53	°F	598
Temp. combined outlet C & D	.54	°F	747
Draft gages			
Heater stack - above damper		" H_2O	-1.0
- below damper		" H_2O	-.06
Heater roof tubes (East cell)		" H_2O	0
(West cell)		" H_2O	0
Heater firebox (West)		" H_2O	-.07
(East)		" H_2O	-.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/25/76

S.G. ≃ 0.070

Test No. 4-5

Parameter	Meter No.	Units	Reading
Time			13:01
Fuel gas flow	FR 156	MMSCFD	3.9
Fuel gas pressure	PI 191	psig	38/53
SR Resid. Surge Drum	LRC-103	%	62
Total flow to #33, 34	LR 882	%	44
SR Residue	FR-123	Bbl/day	6.9
	FR-102	Bbl/day	3.0
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	754
Firebox pressure	PR-153	" H_2O	-.006
Damper position	OPTR-152	% Open	58
Hand indicating controller-East	HIC-149	No Units	10.8
Hand indicating controller-West	HIC-150	No Units	11.6
Oxygen in stack	AR-151	%	4.8
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	790
Pass A - Mid	-2	°F	820
" B "	-3	°F	860
" C "	-4	°F	860
" D "	-5	°F	850
" A Out	-6	°F	1010
" B "	-7	°F	—
" C "	-8	°F	1120
" D "	-9	°F	980
" A Inner	-10	°F	810

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6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-5

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	735
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1250
" " " " SE end	.26	°F	1270
Temp. radiant section - NE	.27	°F	1258
- SE	.28	°F	1313
Temp. heater 33 stack	.29	°F	527
Temp. below conv. - NW	.31	°F	1175
" " " SW	.32	°F	1272
Temp. of radiant section - NW	.33	°F	1246
" " " " SW	.34	°F	1319
Temp. pass C rad. sec. skin	.42	°F	842
" " B " " "	.47	°F	444
" " D " " "	.48	°F	822
Temp. conv. - rad. crossover Pass A	.49	°F	595
" " " " " B	.50	°F	603
Temp. combined outlet A & B	.51	°F	753
Temp. conv. - Rad. crossover Pass C	.52	°F	602
" " " " " D	.53	°F	596
Temp. combined outlet C & D	.54	°F	747
Draft gages			
Heater stack - above damper		" H_2O	-1.03 BOUNCING
- below damper		" H_2O	-0.07
Heater roof tubes (East cell)		" H_2O	0.00
(West cell)		" H_2O	+0.01
Heater firebox (West)		" H_2O	-0.07
(East)		" H_2O	-0.08

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/25/76

S.G. ≃ 0.0705

Test No. 4-5 (OIL + GAS)

Parameter	Meter No.	Units	Reading
Time			13:33
Fuel gas flow	FR 156	MMSCFD	4.0
Fuel gas pressure	PI 191	psig	38/53
SR Resid. Surge Drum	LRC-103	%	62
Total flow to #33, 34	LR 982	%	46
SR Residue	FR-123	Bbl/day	7.0
	FR-102	Bbl/day	3.0
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.8
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	755
Firebox pressure	PR-153	" H_2O	-.015
Damper position	OPTR-152	% ~~Open~~ CI	58 *
Hand indicating controller-East	HIC-149	No Units	10.6
Hand indicating controller-West	HIC-150	No Units	11.6
Oxygen in stack	AR-151	%	4.7
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	800
Pass A - Mid	-2	°F	820
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	1000
" B "	-7	°F	—
" C "	-8	°F	1110
" D "	-9	°F	980
" A Inner	-10	°F	810

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* WHEN CHANGING TO MANUAL TOOK ABOUT 20 MIN. TO RETURN TO OPT. POS.

Control Room Data Sheet

Test No. 4-5

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	738
" B " "	-3	°F	750
" C " "	-4	°F	735
" D " "	-5	°F	740
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1244
" " " " SE end	.26	°F	1265
Temp. radiant section - NE	.27	°F	1253
- SE	.28	°F	1315
Temp. heater 33 stack	.29	°F	525
Temp. below conv. - NW	.31	°F	1171
" " " SW	.32	°F	1272
Temp. of radiant section - NW	.33	°F	1253
" " " " SW	.34	°F	1302
Temp. pass C rad. sec. skin	.42	°F	845
" " B " " "	.47	°F	443
" " D " " "	.48	°F	821
Temp. conv. - rad. crossover Pass A	.49	°F	595
" " " " " B	.50	°F	601
Temp. combined outlet A & B	.51	°F	752
Temp. conv. - Rad. crossover Pass C	.52	°F	602
" " " " " D	.53	°F	595
Temp. combined outlet C & D	.54	°F	745
Draft gages			—
Heater stack - above damper		" H_2O	-1.0
- below damper		" H_2O	-.03
Heater roof tubes (East cell)		" H_2O	+.02
(West cell)		" H_2O	+.02
Heater firebox (West)		" H_2O	-.07
(East)		" H_2O	-.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/25/76

S.G. ≃ 0.070

Test No. 4-5

Parameter	Meter No.	Units	Reading
Time			14:02
Fuel gas flow	FR 156	MMSCFD	4.2
Fuel gas pressure	PI 191	psig	39/54
SR Resid. Surge Drum	LRC-103	%	62
Total flow to #33, 34	LR 882	%	47
SR Residue	FR-123	Bbl/day	6.9
	FR-102	Bbl/day	3.3
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.8
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	756
Firebox pressure	PR-153	" H_2O	-0.008
Damper position	OPTR-152	% Open	58
Hand indicating controller-East	HIC-149	No Units	10.7
Hand indicating controller-West	HIC-150	No Units	11.6
Oxygen in stack	AR-151	%	4.4
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	800
Pass A - Mid	-2	°F	820
" B "	-3	°F	860
" C "	-4	°F	860
" D "	-5	°F	860
" A Out	-6	°F	1000
" B "	-7	°F	—
" C "	-8	°F	1110
" D "	-9	°F	980
" A Inner	-10	°F	810

PI-155 psig 69

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-5

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	———
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	738
" B " "	-3	°F	750
" C " "	-4	°F	735
" D " "	-5	°F	740
Temperature indicating panel console	TI-230	°F	———
Temp. below conv. section - NE end	230.25	°F	1238
" " " " SE end	.26	°F	1267
Temp. radiant section - NE	.27	°F	1260
- SE	.28	°F	1328
Temp. heater 33 stack	.29	°F	525
Temp. below conv. - NW	.31	°F	1174
" " " SW	.32	°F	1269
Temp. of radiant section - NW	.33	°F	1283
" " " " SW	.34	°F	1304
Temp. pass C rad. sec. skin	.42	°F	852
" " B " " "	.47	°F	498
" " D " " "	.48	°F	827
Temp. conv. - rad. crossover Pass A	.49	°F	594
" " " " " B	.50	°F	601
Temp. combined outlet A & B	.51	°F	753
Temp. conv. - Rad. crossover Pass C	.52	°F	601
" " " " " D	.53	°F	595
Temp. combined outlet C & D	.54	°F	746
Draft gages			———
Heater stack - above damper		" H_2O	-1.04
- below damper		" H_2O	-.05
Heater roof tubes (East cell)		" H_2O	+.02
(West cell)		" H_2O	+.01
Heater firebox (West)		" H_2O	-.07
(East)		" H_2O	-.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/25/76

Test No. 4-5

S.G. ≃ 0.71

Parameter	Meter No.	Units	Reading
Time			14:33
Fuel gas flow	FR 156	MMSCFD	3.8
Fuel gas pressure	PI 191	psig	39/55
SR Resid. Surge Drum	LRC-103	%	62
Total flow to #33, 34	LR 882	%	48
SR Residue	FR-123	Bbl/day	7.1
	FR-102	Bbl/day	3.2
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.85
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	754
SR Resid out 33 West	TRC-150	°F	755
Firebox pressure	PR-153	" H_2O	-.01
Damper position	OPTR-152	% ~~Open~~ CI	58
Hand indicating controller-East	HIC-149	No Units	10.6
Hand indicating controller-West	HIC-150	No Units	11.7
Oxygen in stack	AR-151	%	4.8
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	800
Pass A - Mid	-2	°F	830
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	1020
" B "	-7	°F	—
" C "	-8	°F	1120
" D "	-9	°F	980
" A Inner	-10	°F	820

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Control Room Data Sheet

Test No. 4-5

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	735
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1252
" " " " SE end	.26	°F	1272
Temp. radiant section - NE	.27	°F	1272
- SE	.28	°F	1305
Temp. heater 33 stack	.29	°F	526
Temp. below conv. - NW	.31	°F	1177
" " " SW	.32	°F	1277
Temp. of radiant section - NW	.33	°F	1248
" " " " SW	.34	°F	1319
Temp, pass C rad. sec. skin	.42	°F	843
" " B " " "	.47	°F	443
" " D " " "	.48	°F	822
Temp. conv. - rad. crossover Pass A	.49	°F	595
" " " " " B	.50	°F	602
Temp. combined outlet A & B	.51	°F	755
Temp. conv. - Rad. crossover Pass C	.52	°F	602
" " " " " D	.53	°F	596
Temp. combined outlet C & D	.54	°F	746
Draft gages			—
Heater stack - above damper		" H_2O	-1.01
- below damper		" H_2O	-0.05
Heater roof tubes (East cell)		" H_2O	+0.01
(West cell)		" H_2O	+0.01
Heater firebox (West)		" H_2O	-0.07
(East)		" H_2O	-0.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/26/76

Test No. 4-6 (BASELINE)

PROCESS GAS
OFF-SPEC. PROPANE
NATURAL GAS

S.G. = 0.78

Parameter	Meter No.	Units	Reading
Time			10:20
Fuel gas flow	FR 156	MMSCFD	6.2
Fuel gas pressure	PI 191/98	psig	40 / 55
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 882	%	48
SR Residue	FR-123	Bbl/day	6.5
	FR-102	Bbl/day	5.1
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.8
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	757
Firebox pressure	PR-153	" H_2O	-.01
Damper position	OPTR-152	% Open	56
Hand indicating controller-East	HIC-149	No Units	8.2
Hand indicating controller-West	HIC-150	No Units	8.2
Oxygen in stack	AR-151	%	4.8
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	830
" B "	-3	°F	840
" C "	-4	°F	830
" D "	-5	°F	820
" A Out	-6	°F	1010
" B "	-7	°F	—
" C "	-8	°F	1120
" D "	-9	°F	1000
" A Inner	-10	°F	820

Control Room Data Sheet

Test No. 4-6

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	740
" B " "	-3	°F	745
" C " "	-4	°F	745
" D " "	-5	°F	745
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1268
" " " " SE end	.26	°F	1308
Temp. radiant section - NE	.27	°F	1289
- SE	.28	°F	1318
Temp. heater 33 stack	.29	°F	541
Temp. below conv. - NW	.31	°F	1200
" " " SW	.32	°F	1344
Temp. of radiant section - NW	.33	°F	1150
" " " " SW	.34	°F	1416
Temp. pass C rad. sec. skin	.42	°F	816
" " B " " "	.47	°F	444
" " D " " "	.48	°F	811
Temp. conv. - rad. crossover Pass A	.49	°F	595
" " " " " B	.50	°F	602
Temp. combined outlet A & B	.51	°F	755
Temp. conv. - Rad. crossover Pass C	.52	°F	603
" " " " " D	.53	°F	596
Temp. combined outlet C & D	.54	°F	751
Draft gages			—
Heater stack - above damper		" H_2O	-0.70
- below damper		" H_2O	-0.02
Heater roof tubes (East cell)		" H_2O	+0.02
(West cell)		" H_2O	+0.03
Heater firebox (West)		" H_2O	-0.06
(East)		" H_2O	-0.07

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/26/76

Test No. 4-6 BASELINE

S.G. = 0.78

Page 1

Parameter	Meter No.	Units	Reading
Time			10:50
Fuel gas flow	FR 156	MMSCFD	6.3
Fuel gas pressure	PI 191	psig	39/60
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	LR 882	%	47
SR Residue	FR-123	Bbl/day	6.9
	FR-102	Bbl/day	3.9
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.8
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	754
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-0.016
Damper position	OPTR-152	% Open	55
Hand indicating controller-East	HIC-149	No Units	8.2
Hand indicating controller-West	HIC-150	No Units	8.3
Oxygen in stack	AR-151	%	5.5
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	820
" B "	-3	°F	850
" C "	-4	°F	830
" D "	-5	°F	830
" A Out	-6	°F	1020
" B "	-7	°F	—
" C "	-8	°F	1150
" D "	-9	°F	1000
" A Inner	-10	°F	820

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-6

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	743
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1272
" " " " SE end	.26	°F	1307
Temp. radiant section - NE	.27	°F	1291
- SE	.28	°F	1325
Temp. heater 33 stack	.29	°F	546
Temp. below conv. - NW	.31	°F	1199
" " " SW	.32	°F	1343
Temp. of radiant section - NW	.33	°F	1161
" " " " SW	.34	°F	1413
Temp. pass C rad. sec. skin	.42	°F	816
" " B " " "	.47	°F	440
" " D " " "	.48	°F	811
Temp. conv. - rad. crossover Pass A	.49	°F	597
" " " " " B	.50	°F	604
Temp. combined outlet A & B	.51	°F	754
Temp. conv. - Rad. crossover Pass C	.52	°F	604
" " " " " D	.53	°F	597
Temp. combined outlet C & D	.54	°F	751
Draft gages			—
Heater stack - above damper		" H_2O	-1.05
- below damper		" H_2O	-0.13
Heater roof tubes (East cell)		" H_2O	-0.03
(West cell)		" H_2O	0
Heater firebox (West)		" H_2O	-0.09
(East)		" H_2O	-0.09

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/26/76

Test No. 4-7 25% Boos (1, 3, 14, & 16) S. G. ≈ 0.78

Parameter	Meter No.	Units	Reading
Time			11:56
Fuel gas flow	FR 156	MMSCFD	6.3
Fuel gas pressure	PI 191	psig	39/61
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 882	%	43
SR Residue	FR-123	Bbl/day	6.5
(1500)	FR-102	Bbl/day	5.0
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.85
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.8
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	754
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-.008
Damper position	OPTR-152	% Open	53
Hand indicating controller-East	HIC-149	No Units	8.2
Hand indicating controller-West	HIC-150	No Units	8.3
Oxygen in stack	AR-151	%	6.7
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	830
" B "	-3	°F	840
" C "	-4	°F	830
" D "	-5	°F	830
" A Out	-6	°F	1040
" B "	-7	°F	—
" C "	-8	°F	1160
" D "	-9	°F	1000
" A Inner	-10	°F	830

Control Room Data Sheet

Test No._____

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	520
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1302
" " " " SE end	.26	°F	1326
Temp. radiant section - NE	.27	°F	1312
- SE	.28	°F	1281
Temp. heater 33 stack	.29	°F	556
Temp. below conv. - NW	.31	°F	1206
" " " SW	.32	°F	1317
Temp. of radiant section - NW	.33	°F	1182
" " " " SW	.34	°F	1341
Temp. pass C rad. sec. skin	.42	°F	819
" " B " " "	.47	°F	435
" " D " " "	.48	°F	813
Temp. conv. - rad. crossover Pass A	.49	°F	597
" " " " " B	.50	°F	606
Temp. combined outlet A & B	.51	°F	753
Temp. conv. - Rad. crossover Pass C	.52	°F	607
" " " " " D	.53	°F	600
Temp. combined outlet C & D	.54	°F	750
Draft gages			—
Heater stack - above damper		" H_2O	-1.04
- below damper		" H_2O	-0.16
Heater roof tubes (East cell)		" H_2O	-0.02
(West cell)		" H_2O	+0.01
Heater firebox (West)		" H_2O	-0.08
(East)		" H_2O	-0.09

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KVB

Location 4

Control Room Data Sheet

Date 5/26/76

Test No. 4-7

S.G. = 0.78

Boos Closed AIR on in Service Brns.

Parameter	Meter No.	Units	Reading
Time			12:40
Fuel gas flow	FR 156	MMSCFD	6.5
Fuel gas pressure	PI 191	psig	38/64
SR Resid. Surge Drum	LRC-103	%	63
Total flow to #33, 34	LR 382	%	27
SR Residue	FR-123	Bbl/day	6.4
	FR-102	Bbl/day	5.3
	FR-128	Bbl/day	5.1
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	758
Firebox pressure	PR-153	" H_2O	-.011
Damper position	OPTR-152	% ~~Open~~ Cl	52
Hand indicating controller-East	HIC-149	No Units	8.2
Hand indicating controller-West	HIC-150	No Units	8.3
Oxygen in stack	AR-151	%	6.7
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	830
" B "	-3	°F	830
" C "	-4	°F	860
" D "	-5	°F	860
" A Out	-6	°F	1040
" B "	-7	°F	—
" C "	-8	°F	1120
" D "	-9	°F	1000
" A Inner	-10	°F	820

Control Room Data Sheet

Test No. 4-7

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	525
Pass A oil out	-2	°F	750
" B " "	-3	°F	740
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1297
" " " " SE end	.26	°F	1330
Temp. radiant section - NE	.27	°F	1301
- SE	.28	°F	1275
Temp. heater 33 stack	.29	°F	556
Temp. below conv. - NW	.31	°F	1207
" " " SW	.32	°F	1333
Temp. of radiant section - NW	.33	°F	1210
" " " " SW	.34	°F	1372
Temp. pass C rad. sec. skin	.42	°F	822
" " B " " "	.47	°F	435
" " D " " "	.48	°F	815
Temp. conv. - rad. crossover Pass A	.49	°F	598
" " " " " B	.50	°F	606
Temp. combined outlet A & B	.51	°F	753
Temp. conv. - Rad. crossover Pass C	.52	°F	606
" " " " " D	.53	°F	600
Temp. combined outlet C & D	.54	°F	752
Draft gages			—
Heater stack - above damper		" H_2O	-1.05
- below damper		" H_2O	-0.17
Heater roof tubes (East cell)		" H_2O	-0.01
(West cell)		" H_2O	+0.02
Heater firebox (West)		" H_2O	-0.09
(East)		" H_2O	-0.09

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KVB

Location 4

Control Room Data Sheet

Date 5/26/76 #1, 16 E 1, 3, 16 W Boos A/R C1 SG = 0.77

Test No. 4-8 (BASELINE) Page 1

Parameter	Meter No.	Units	Reading
Time			09:06
Fuel gas flow	FR 156	MMSCFD	6.7
Fuel gas pressure	PI 191	psig	38/57
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 882	%	45
SR Residue X 5800	FR-123	Bbl/day	7.0
X 1500	FR-102	Bbl/day	3.4
X 8670	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.85
- Pass B	FRC-130	Bbl/day	7.8
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	754
SR Resid out 33 West	TRC-150	°F	760
Firebox pressure	PR-153	" H_2O	-0.012
Damper position	OPTR-152	% ~~Open~~ C1	57
Hand indicating controller-East	HIC-149	No Units	8.1
Hand indicating controller-West	HIC-150	No Units	8.3
Oxygen in stack	AR-151	%	5.8 ← #34
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	830
" B "	-3	°F	850
" C "	-4	°F	850
" D "	-5	°F	850
" A Out	-6	°F	1000
" B "	-7	°F	—
" C "	-8	°F	1090
" D "	-9	°F	990
" A Inner	-10	°F	830

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Control Room Data Sheet

Test No. 4-8

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	535
Pass A oil out	-2	°F	745
" B " "	-3	°F	745
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1241
" " " " SE end	.26	°F	1294
Temp. radiant section - NE	.27	°F	1292
- SE	.28	°F	1330
Temp. heater 33 stack	.29	°F	542
Temp. below conv. - NW	.31	°F	1172
" " " SW	.32	°F	1352
Temp. of radiant section - NW	.33	°F	1205
" " " " SW	.34	°F	1429
Temp. pass C rad. sec. skin	.42	°F	821
" " B " " "	.47	°F	439
" " D " " "	.48	°F	817
Temp. conv. - rad. crossover Pass A	.49	°F	602
" " " " " B	.50	°F	610
Temp. combined outlet A & B	.51	°F	755
Temp. conv. - Rad. crossover Pass C	.52	°F	611
" " " " " D	.53	°F	605
Temp. combined outlet C & D	.54	°F	753
Draft gages			—
Heater stack - above damper		" H_2O	-1.03
- below damper		" H_2O	-0.09
Heater roof tubes (East cell)		" H_2O	-0.02
(West cell)		" H_2O	~~0~~
Heater firebox (West)		" H_2O	-0.10
(East)		" H_2O	-0.10

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/27/76 Boos 4, 7, 10, 13 E+W AIR open on all SG ≈ 0.78

Test No. 4-9 Page 1

Parameter	Meter No.	Units	Reading
Time			10:05
Fuel gas flow	FR 156	MMSCFD	6.0
Fuel gas pressure	PI 191	psig	38/56
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 882	%	45
SR Residue	FR-123	Bbl/day	6.9
	FR-102	Bbl/day	4.1
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.8
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	760
Firebox pressure	PR-153	" H_2O	-0.011
Damper position	OPTR-152	% ~~Open~~ CI	55
Hand indicating controller-East	HIC-149	No Units	8.1
Hand indicating controller-West	HIC-150	No Units	8.2
Oxygen in stack	AR-151	%	6.0 ← #34
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	820
" B "	-3	°F	920
" C "	-4	°F	880
" D "	-5	°F	960
" A Out	-6	°F	970
" B "	-7	°F	—
" C "	-8	°F	1050
" D "	-9	°F	980
" A Inner	-10	°F	830

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-9

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	745
" B " "	-3	°F	745
" C " "	-4	°F	746
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1187
" " " " SE end	.26	°F	1217
Temp. radiant section - NE	.27	°F	1453
- SE	.28	°F	1476
Temp. heater 33 stack	.29	°F	540
Temp. below conv. - NW	.31	°F	1238
" " " SW	.32	°F	1312
Temp. of radiant section - NW	.33	°F	1399
" " " " SW	.34	°F	1382
Temp. pass C rad. sec. skin	.42	°F	843
" " B " " "	.47	°F	467
" " D " " "	.48	°F	885
Temp. conv. - rad. crossover Pass A	.49	°F	600
" " " " " B	.50	°F	607
Temp. combined outlet A & B	.51	°F	754
Temp. conv. - Rad. crossover Pass C	.52	°F	608
" " " " " D	.53	°F	602
Temp. combined outlet C & D	.54	°F	753
Draft gages			—
Heater stack - above damper		" H_2O	-1.05
- below damper		" H_2O	-0.12
Heater roof tubes (East cell)		" H_2O	-0.02
(West cell)		" H_2O	0.00
Heater firebox (West)		" H_2O	-0.10
(East)		" H_2O	-0.10

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KVB

Location 4

Control Room Data Sheet

S.G. = 0.78

Date 5/27/76

Test No. 4-9

Parameter	Meter No.	Units	Reading
Time			10:31
Fuel gas flow	FR 156	MMSCFD	6.4
Fuel gas pressure	PI 191	psig	38/55
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 982	%	45
SR Residue	FR-123	Bbl/day	6.9
	FR-102	Bbl/day	3.4
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.8
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	753
SR Resid out 33 West	TRC-150	°F	760
Firebox pressure	PR-153	" H_2O	-0.013
Damper position	OPTR-152	% ~~Open~~ Cl	55
Hand indicating controller-East	HIC-149	No Units	8.2
Hand indicating controller-West	HIC-150	No Units	8.2
Oxygen in stack	AR-151	%	6.0 ← #34
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	830
Pass A - Mid	-2	°F	840
" B "	-3	°F	900
" C "	-4	°F	880
" D "	-5	°F	960
" A Out	-6	°F	970
" B "	-7	°F	—
" C "	-8	°F	1060
" D "	-9	°F	980
" A Inner	-10	°F	850

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Control Room Data Sheet

Test No. 4-9

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	740
" B " "	-3	°F	745
" C " "	-4	°F	745
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	———
Temp. below conv. section - NE end	230.25	°F	1190
" " " " SE end	.26	°F	1216
Temp. radiant section - NE	.27	°F	1452
- SE	.28	°F	1470
Temp. heater 33 stack	.29	°F	540
Temp. below conv. - NW	.31	°F	1243
" " " SW	.32	°F	1310
Temp. of radiant section - NW	.33	°F	1398
" " " " SW	.34	°F	1388
Temp. pass C rad. sec. skin	.42	°F	845
" " B " " "	.47	°F	471
" " D " " "	.48	°F	884
Temp. conv. - rad. crossover Pass A	.49	°F	600
" " " " " B	.50	°F	607
Temp. combined outlet A & B	.51	°F	754
Temp. conv. - Rad. crossover Pass C	.52	°F	608
" " " " " D	.53	°F	601
Temp. combined outlet C & D	.54	°F	754
Draft gages			———
Heater stack - above damper		" H_2O	-1.03
- below damper		" H_2O	-0.11
Heater roof tubes (East cell)		" H_2O	-0.02
(West cell)		" H_2O	~~0~~
Heater firebox (West)		" H_2O	-0.09
(East)		" H_2O	-0.09

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KVB

Location 4

Control Room Data Sheet

Date 5/27/76 S.G. = 0.78

Test No. 4-9 RECALIB. VAN O_2 Page 1

Parameter	Meter No.	Units	Reading
Time			11:55
Fuel gas flow	FR 156	MMSCFD	6.2
Fuel gas pressure	PI 191	psig	39/56
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 882	%	45
SR Residue	FR-123	Bbl/day	7.0
	FR-102	Bbl/day	3.8
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.8
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	755
SR Resid out 33 West	TRC-150	°F	761
Firebox pressure	PR-153	" H_2O	- 0.012
Damper position	OPTR-152	% ~~Open~~ CI	54
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	6.5
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	830
" B "	-3	°F	~~850~~ 900
" C "	-4	°F	880
" D "	-5	°F	960
" A Out	-6	°F	980
" B "	-7	°F	—
" C "	-8	°F	1050
" D "	-9	°F	980
" A Inner	-10	°F	840

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Control Room Data Sheet

Test No. 4-9

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	530
Pass A oil out	-2	°F	745
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1188
" " " " SE end	.26	°F	1208
Temp. radiant section - NE	.27	°F	1465
- SE	.28	°F	1459
Temp. heater 33 stack	.29	°F	542
Temp. below conv. - NW	.31	°F	1247
" " " SW	.32	°F	1305
Temp. of radiant section - NW	.33	°F	1388
" " " " SW	.34	°F	1400
Temp. pass C rad. sec. skin	.42	°F	845
" " B " " "	.47	°F	472
" " D " " "	.48	°F	884
Temp. conv. - rad. crossover Pass A	.49	°F	600
" " " " " B	.50	°F	608
Temp. combined outlet A & B	.51	°F	755
Temp. conv. - Rad. crossover Pass C	.52	°F	608
" " " " " D	.53	°F	602
Temp. combined outlet C & D	.54	°F	754
Draft gages			—
Heater stack - above damper		" H_2O	-1.02
- below damper		" H_2O	-0.12
Heater roof tubes (East cell)		" H_2O	-0.01
(West cell)		" H_2O	+0.015
Heater firebox (West)		" H_2O	-0.08
(East)		" H_2O	-0.065

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

SG = 0.77

Date 5/27/76

Test No. 4-10

BURNERS #4,8,9 Boos and AIR open

Parameter	Meter No.	Units	Reading
Time			13:00
Fuel gas flow	FR 156	MMSCFD	6.2
Fuel gas pressure	PI 191/198	psig	39/57
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 882	%	45
SR Residue	FR-123	Bbl/day	6.9
	FR-102	Bbl/day	3.9
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.8
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	755
SR Resid out 33 West	TRC-150	°F	762
Firebox pressure	PR-153	" H_2O	-0.005
Damper position	OPTR-152	% Open	56
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	6.0
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	820
" B "	-3	°F	910
" C "	-4	°F	880
" D "	-5	°F	940
" A Out	-6	°F	960
" B "	-7	°F	—
" C "	-8	°F	1080
" D "	-9	°F	980
" A Inner	-10	°F	850

Control Room Data Sheet

Test No. 4-10

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	535
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1212
" " " " SE end	.26	°F	1220
Temp. radiant section - NE	.27	°F	1497
- SE	.28	°F	1525
Temp. heater 33 stack	.29	°F	542
Temp. below conv. - NW	.31	°F	1258
" " " SW	.32	°F	1271
Temp. of radiant section - NW	.33	°F	1458
" " " " SW	.34	°F	1380
Temp. pass C rad. sec. skin	.42	°F	848
" " B " " "	.47	°F	472 ?
" " D " " "	.48	°F	879
Temp. conv. - rad. crossover Pass A	.49	°F	600
" " " " " B	.50	°F	608
Temp. combined outlet A & B	.51	°F	754
Temp. conv. - Rad. crossover Pass C	.52	°F	608
" " " " " D	.53	°F	601
Temp. combined outlet C & D	.54	°F	753
Draft gages			—
Heater stack - above damper		" H_2O	-1.04
- below damper		" H_2O	-0.09
Heater roof tubes (East cell)		" H_2O	-0.01
(West cell)		" H_2O	+0.01
Heater firebox (West)		" H_2O	-0.08
(East)		" H_2O	-0.09

6002 TP 5/29/76

KVB

Location 4

Control Room Data Sheet

Date 5/27/76 Boos S.G. = 0.78

Test No. 4-11 6,8,9,11 + Air Reg Open

Parameter	Meter No.	Units	Reading
Time			13:33
Fuel gas flow	FR 156	MMSCFD	6.3
Fuel gas pressure	PI 191	psig	39/56
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 982	%	45
SR Residue	FR-123	Bbl/day	6.95
	FR-102	Bbl/day	3.1
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	754
SR Resid out 33 West	TRC-150	°F	760
Firebox pressure	PR-153	" H_2O	-0.03
Damper position	OPTR-152	% Open	53
Hand indicating controller-East	HIC-149	No Units	—
Hand indicating controller-West	HIC-150	No Units	—
Oxygen in stack	AR-151	%	5.6
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	830
Pass A - Mid	-2	°F	830
" B "	-3	°F	920
" C "	-4	°F	910
" D "	-5	°F	950
" A Out	-6	°F	950
" B "	-7	°F	—
" C "	-8	°F	1030
" D "	-9	°F	960
" A Inner	-10	°F	850

Control Room Data Sheet

Test No. 4-11

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	535
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	illegible
" " " " SE end	.26	°F	1218
Temp. radiant section - NE	.27	°F	1500
- SE	.28	°F	1574
Temp. heater 33 stack	.29	°F	544
Temp. below conv. - NW	.31	°F	1319
" " " SW	.32	°F	1325
Temp. of radiant section - NW	.33	°F	1449
" " " " SW	.34	°F	1401
Temp. pass C rad. sec. skin	.42	°F	871
" " B " " "	.47	°F	477
" " D " " "	.48	°F	895
Temp. conv. - rad. crossover Pass A	.49	°F	602
" " " " " B	.50	°F	illegible
Temp. combined outlet A & B	.51	°F	illegible
Temp. conv. - Rad. crossover Pass C	.52	°F	609
" " " " " D	.53	°F	603
Temp. combined outlet C & D	.54	°F	illegible
Draft gages			—
Heater stack - above damper		" H_2O	-1.02
- below damper		" H_2O	-0.02
Heater roof tubes (East cell)		" H_2O	-0.02
(West cell)		" H_2O	—
Heater firebox (West)		" H_2O	-0.09
(East)		" H_2O	-0.09

KVB

Location 4

Control Room Data Sheet

Date 5/27/76

Test No. 4-11 Boos (SALT)

SG = 0.78

Parameter	Meter No.	Units	Reading
Time			14:22
Fuel gas flow	FR 156	MMSCFD	6.6
Fuel gas pressure	PI 191	psig	39/57
SR Resid. Surge Drum	LRC-103	%	64
Total flow to #33, 34	LR 882	%	46
SR Residue	FR-123	Bbl/day	7.0
	FR-102	Bbl/day	3-8
	FR-128	Bbl/day	5.2
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.9
- Pass B	FRC-130	Bbl/day	7.9
- Pass C	FRC-131	Bbl/day	7.9
- Pass D	FRC-132	Bbl/day	7.9
SR Resid out 33 East	TRC-149	°F	754
SR Resid out 33 West	TRC-150	°F	760
Firebox pressure	PR-153	" H_2O	-0.016
Damper position	OPTR-152	% Open	55
Hand indicating controller-East	HIC-149	No Units	———
Hand indicating controller-West	HIC-150	No Units	———
Oxygen in stack	AR-151	%	6.3
Tube wall temperature	TR-231	°F	———
Above convection section	-1	°F	820
Pass A - Mid	-2	°F	820
" B "	-3	°F	920
" C "	-4	°F	910
" D "	-5	°F	950
" A Out	-6	°F	950
" B "	-7	°F	———
" C "	-8	°F	1040
" D "	-9	°F	960
" A Inner	-10	°F	870

SALT = SAME AS LAST TEST

Control Room Data Sheet

Test No. 4-11

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	535
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	750
" D " "	-5	°F	750
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1167
" " " " SE end	.26	°F	1216
Temp. radiant section - NE	.27	°F	1509
- SE	.28	°F	1591
Temp. heater 33 stack	.29	°F	539
Temp. below conv. - NW	.31	°F	1330
" " " SW	.32	°F	1333
Temp. of radiant section - NW	.33	°F	1468
" " " " SW	.34	°F	1428
Temp. pass C rad. sec. skin	.42	°F	874
" " B " " "	.47	°F	483
" " D " " "	.48	°F	900
Temp. conv. - rad. crossover Pass A	.49	°F	601
" " " " " B	.50	°F	608
Temp. combined outlet A & B	.51	°F	756
Temp. conv. - Rad. crossover Pass C	.52	°F	608
" " " " " D	.53	°F	602
Temp. combined outlet C & D	.54	°F	755
Draft gages			—
Heater stack - above damper		" H_2O	-1.03
- below damper		" H_2O	-0.12
Heater roof tubes (East cell)		" H_2O	-0.02
(West cell)		" H_2O	~~0~~
Heater firebox (West)		" H_2O	-0.08
(East)		" H_2O	-0.08

KVB

Location 4

Control Room Data Sheet

S.G = .72

Date 5-28-76

Test No. 4-12 3 OIL GUNS IN EAST SIDE

Parameter	Meter No.	Units	Reading
Time			0900
Fuel gas flow	FR 156	MMSCFD	4.5
Fuel gas pressure	PI 191/198	psig	39/47
SR Resid. Surge Drum	LRC-103	%	66
Total flow to #33, 34	LR 882	%	46
SR Residue	FR-123	Bbl/day	7.0
	FR-102	Bbl/day	~~0~~
	FR-128	Bbl/day	4.6
SR Residue to Htr. 33 - Pass A	FRC-129	Bbl/day	7.2
- Pass B	FRC-130	Bbl/day	5.2
- Pass C	FRC-131	Bbl/day	7.2
- Pass D	FRC-132	Bbl/day	7.2
SR Resid out 33 East	TRC-149	°F	755
SR Resid out 33 West	TRC-150	°F	760
Firebox pressure	PR-153	" H_2O	.005
Damper position	OPTR-152	% Open	60
Hand indicating controller-East	HIC-149	No Units	/
Hand indicating controller-West	HIC-150	No Units	
Oxygen in stack	AR-151	%	5.8
Tube wall temperature	TR-231	°F	—
Above convection section	-1	°F	800
Pass A - Mid	-2	°F	820
" B "	-3	°F	840
" C "	-4	°F	840
" D "	-5	°F	815
" A Out	-6	°F	1000
" B "	-7	°F	—
" C "	-8	°F	1060
" D "	-9	°F	1000
" A Inner	-10	°F	840

NAT. GAS FLOW: 2.74 MSCFD

REF. GAS 5.2 × 0.985 MSCFD

REF. GAS 4.34 × 1.433 MSCFD

6002 TP 5/20/76

Control Room Data Sheet

Test No. 4-12

Parameter	Meter No.	Units	Reading
Oil Pass temperature	TR-232	°F	—
SR residue feed to 33 & 34	-1	°F	545
Pass A oil out	-2	°F	750
" B " "	-3	°F	750
" C " "	-4	°F	760
" D " "	-5	°F	745
Temperature indicating panel console	TI-230	°F	—
Temp. below conv. section - NE end	230.25	°F	1222
" " " " SE end	.26	°F	1236
Temp. radiant section - NE	.27	°F	1253
- SE	.28	°F	1272
Temp. heater 33 stack	.29	°F	518
Temp. below conv. - NW	.31	°F	1152
" " " SW	.32	°F	1244
Temp. of radiant section - NW	.33	°F	1248
" " " " SW	.34	°F	1301
Temp. pass C rad. sec. skin	.42	°F	829
" " B " " "	.47	°F	433
" " D " " "	.48	°F	819
Temp. conv. - rad. crossover Pass A	.49	°F	609
" " " " " B	.50	°F	616
Temp. combined outlet A & B	.51	°F	755
Temp. conv. - Rad. crossover Pass C	.52	°F	615
" " " " " D	.53	°F	609
Temp. combined outlet C & D	.54	°F	753
Draft gages			
Heater stack - above damper		" H_2O	-1.0
- below damper		" H_2O	+.07
Heater roof tubes (East cell)		" H_2O	0
(West cell)		" H_2O	+.02
Heater firebox (West)		" H_2O	+.015
(East)		" H_2O	+.015

6002 TP 5/29/76

Location 4

Fuel Oil Analysis

Test	4-4
Carbon, %	87.38
Hydrogen, %	11.87
Nitrogen, %	0.28
Sulfur, %	0.40
Ash, %	0.004
Oxygen (by difference), %	0.07
Gross Heat of Combustion, BTU/lb	19,070
Net Heat of Combustion, BTU/lb	17,980

Fuel Gas Analyses

Test	4-1	4-2	4-5	4-6	4-8
Oxygen	4.23	< 0.01	0.13	0.21	0.10
Nitrogen	16.3	0.07	1.11	1.68	2.10
Carbon Dioxide	0.36	0.060	0.32	0.059	0.14
Carbon Monoxide	0.52	0.71	0.54	0.62	0.57
Hydrogen	9.29	12.9	12.8	12.7	11.8
Methane	51.79	49.11	61.01	49.4	52.42
Ethane	9.63	17.2	12.8	16.2	14.3
Ethylene	1.07	0.96	1.41	1.71	1.62
Total C3	5.24	16.2	7.44	14.7	15.1
Total C4	1.02	1.72	1.55	1.92	0.91
Total C5	0.50	0.96	0.79	0.73	0.86
Total C6	0.054	0.11	0.10	0.068	0.087
Heating Value (BTU dry/SCF)	932.6	1372	1186	1325	1301

PROCESS HEATER DESIGN DATA

Location No. 5 Unit No. 1

Unit Description THE HEATER IS A VERTICALLY FIRED NATURAL DRAFT PROCESS HEATER EQUIPPED WITH 16 FLOOR MOUNTED BURNERS IN A SINGLE LINE.

Installation Date 1974

Burner Description 16 COMBINATION OIL/GAS BURNERS

Test Fuel REFINERY GAS

Fuel Temp. at Burner (°F) AMBIENT

Primary Air Temp. (°F) AMBIENT

Heater Rating 54.4×10^6 BTU/HR.

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 5-1 Date 6-2-76 Location 5 Engr._____

Unit No._____ Fuel_____ Capacity_____

Unit Type_____ Burner Type_____

BASELINE

1. Test No.	5-1		5-1		5-1		5-1		5-1	
2. Date	6-2-76		6-2-76		6-2-76		6-2-76		6-2-76	
3. Time	0900		0940		1000		1030		1100	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	4.6		4.4		4.3		4.4		4.3	
9. NOx (hot) read/3% O_2 (ppm)*	74	81	72	78	78	84	76	82	76	82
10. NO (hot) read/3% O_2 (ppm)*	71	78	71	77	77	83	75	81	75	81
11. NO_2 (hot) read/3% O_2 (ppm)*	3	3	1	1	1	1	1	1	1	1
12. NO (cold) read/3% O_2 (ppm)*	84	92	86	93	90	97	89	97	89	96
13. Carbon Dioxide (%)	10.0		10.2		10.3		10.4		10.1	
14. Carbon Monoxide (ppm) uncor/cor*	10	11	12	13	10	11	10	11	10	11
15. Hydrocarbon (ppm) uncor/cor*	3	3.3	2	2.2	2	2.2	4	4.3	4	4.3
16. Sulfur Dioxide (ppm) uncor/cor*	5	5.5	4	4.3	3	3.2	6	6.5	9	9.7
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	64		63		64		64		63.5	
19. Dew Point Temp. (°F/°C)	62		62		61.5		62		61.5	
20. Atmos. Pressure (in. Hg)	29.89		29.9		29.91		29.92		29.91	
21. Relative Humidity (%)	90		94		87		90		90	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 5/1-2 Date 6-3-76 Location 5 Engr._____

Unit No. 1 Fuel GAS Capacity_____

Unit Type_____ Burner Type_____

1. Test No.	5-2		5-2		5-2		5-2		5-2	
2. Date	6-2-76		6-2-76		6-2-76		6-2-76		6-2-76	
3. Time	1200		1230		1300		1330		1400	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	5.5		5.35		5.4		5.35		5.2	
9. NOx (hot) read/3% O_2 (ppm)*	75	87	74	85	76	88	77	89	76	87
10. NO (hot) read/3% O_2 (ppm)*	73	85	74	85	75	87	76	87	75	85
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	0	0	1	1	1	1	1	1
12. NO (cold) read/3% O_2 (ppm)*	90	105	90	104	90	104	90	104	92	105
13. Carbon Dioxide (%)	9.7		9.6		9.6		9.8		9.8	
14. Carbon Monoxide (ppm) uncor/cor*	12	14	15	17	10	12	10	12	10	11
15. Hydrocarbon (ppm) uncor/cor*	3	3.5	4	4.6	2	2.1	2	2.2	2	2.3
16. Sulfur Dioxide (ppm) uncor/cor*	8	9.3	6	6.9	8	8.5	5	5.5	8	9.1
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	67		—		—		68		70	
19. Dew Point Temp. (°F/°C)	62		63.5		—		64		65	
20. Atmos. Pressure (in. Hg)	29.9		29.9		29.9		29.9		29.89	
21. Relative Humidity (%)	76%		—		—		81%		78%	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 5/1-3 Date 6-3-76 Location 5 Engr._____

Unit No. 1 Fuel GAS Capacity_____

Unit Type_____ Burner Type_____

1. Test No.	5-3		5-3		5-3		5-3		5-3	
2. Date	6-3-76		6-3-76		6-3-76		6-3-76		6-3-76	
3. Time	0915		1000		1030		1100		1130	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	3.6		3.3		3.3		3.45		3.4	
9. NOx (hot) read/3% O_2 (ppm)*	62	64	68	69	71	72	70	72	70	72
10. NO (hot) read/3% O_2 (ppm)*	61	63	67	68	71	72	68	70	70	72
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	1	1	0	0	2	2	0	0
12. NO (cold) read/3% O_2 (ppm)*	79	82	79	80	81	82	80	82	81	83
13. Carbon Dioxide (%)	10.8		10.8		11.1		10.6		11.0	
14. Carbon Monoxide (ppm) uncor/cor*	10	10	10	10	10	10	10	10	10	10
15. Hydrocarbon (ppm) uncor/cor*	2		2		1		1		1	
16. Sulfur Dioxide (ppm) uncor/cor*	5		7		10		8		9	
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	65		68		68		68		68	
19. Dew Point Temp. (°F/°C)	61		62		62		62		62	
20. Atmos. Pressure (in. Hg)	29.89		29.9		29.88		29.89		29.9	
21. Relative Humidity (%)	81		72		72		72		76	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

PRELIMINARY DATA. NO CONTROL ROOM DATA.

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 5/1-4 Date 6-3-76 Location 5 Engr._____

Unit No. 1 Fuel_____ Capacity_____

Unit Type_____ Burner Type_____

5/1-4C ↓

1. Test No.	5-4		5-4		5-4		5-4			
2. Date	6-3-76		6-3-76		6-3-76		6-3-76			
3. Time	1245		1320		1355		1515			
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	5.0		10.0		8.9		5.5			
9. NOx (hot) read/3% O_2 (ppm)*	71	80	37	61	41	61	96	111		
10. NO (hot) read/3% O_2 (ppm)*	69	78	35	57	43	64	95	110		
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	2	3	2	3	1	1		
12. NO (cold) read/3% O_2 (ppm)*	83	93	46	75	49	73	110	128		
13. Carbon Dioxide (%)	10.0		6.6		7.4		10.4			
14. Carbon Monoxide (ppm) uncor/cor*	8	9	7	11.5	7	10.4	10	12		
15. Hydrocarbon (ppm) uncor/cor*	0		0		1	1.5	0			
16. Sulfur Dioxide (ppm) uncor/cor*	5	5.6	4	6.5	6	8.9	9	10		
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	69		70		70		72			
19. Dew Point Temp. (°F/°C)	64		63		63		66			
20. Atmos. Pressure (in. Hg)	29.9		29.9		29.89		29.89			
21. Relative Humidity (%)	77		69		69		73			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-1 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			9:07
B-100 Temperature	TR-201-H100	°F	927
Reformer Charge	FR-303	1000 BBLD	12.0
B-100 Outlet Temp	TIC-201	°F	927
Stack O_2		%	5.7
Reformer Charge B-100B, B-100D	FIC-301,302	1000 BBLD	6.0/6.0
Firebox, west	TI-1-110	°F	1257
Firebox, east	-111	°F	1221
STEAM FLOW		#/HR x 10^3	37.0
STEAM TEMP./PRESS			448°/—
Heaters outlet	-114	°F	926
tubeskin West	-115	°F	1003
"	-116	°F	1021
"	-117	°F	1066
"	-118	°F	1050
"	-119	°F	1003
" to	-120	°F	985
"	-121	°F	005
"	-122	°F	918
"	-123	°F	953
"	-124	°F	1002
"	-125	°F	1000
" East	-126	°F	1023

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1002
	139	°F	1050
	140	°F	005
to	141	°F	1059
	142	°F	1049
East	143	°F	1040
Top Convection South end	244	°F	401
Bottom Convection Section	248	FF	1200
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	$2.65 \times 348 = 922 \times 10^3$
Gas Header Press.		psig	10
Draft Gages	--	--	—
Firebox East/WEST	—	inches water	-.64 / -.65
Ref. Heaters South stack below Dampers	—	inches water	-.13
Ref. Heaters South Stack above Dampers	—	inches water	-.48
Conv. sect. upper between 100/101	—	inches water	-.2
Conv. sect. center between 100/101	—	inches water	-.2
Conv. sect. lower between 100/101	—	inches water	-.2

BRN. IN SERV. 2, 4, 6, 9, 13, 15

BRN. OUT OF SERV. REST

REGIST. CLOSED ON BOOS

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-1 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			0940
H-100 Temperature	TR-201-H100	°F	927
Reformer Charge	FR-303	1000 BBLD	12
H-100 Outlet Temp	TIC-201	°F	927
Stack O_2		%	0/5
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-110	°F	1257
Firebox, east	-111	°F	1219
STEAM FLOW			37K
STEAM PRESS./TEMP.			—/448°
Heaters outlet	-114	°F	927
tubeskin West	-115	°F	999
"	-116	°F	1018
"	-117	°F	1059
"	-118	°F	1049
"	-119	°F	1004
" to	-120	°F	983
"	-121	°F	0/5
"	-122	°F	925
"	-123	°F	959
"	-124	°F	1002
"	-125	°F	1013
" East	-126	°F	1032

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1046
	139	°F	1055
	140	°F	—
to	141	°F	1055
	142	°F	1034
East	143	°F	1024
Top Convection South end	244	°F	400
Bottom Convection Section	248	PF	.1197
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.65
Gas Header Press.		psig	10
Draft Gages	--	--	--
Firebox East	--	inches water	-.65 / -.65
Ref. Heaters South stack below Dampers	—	inches water	-.14
Ref. Heaters South Stack above Dampers	—	inches water	-.49
Conv. sect. upper between 100/101	—	inches water	-.19
Conv. sect. center between 100/101	—	inches water	-.19
Conv. sect. lower between 100/101	—	inches water	-.20

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-1 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			10:05
H-100 Temperature	TR-201-H100	°F	927
Reformer Charge	FR-303	1000 BBLD	12.0
H-100 Outlet Temp	TIC-201	°F	927
Stack O_2		%	005
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6.0/6.0
Firebox, west	TI-1-110	°F	1257
Firebox, east	-111	°F	1226
STEAM FLOW			37 K
STEAM PRESS./TEMP.			—/448°
Heaters outlet	-114	°F	927
tubeskin West	-115	°F	997
"	-116	°F	1019
"	-117	°F	1060
"	-118	°F	1052
"	-119	°F	1010
" to	-120	°F	988
"	-121	°F	—
"	-122	°F	923
"	-123	°F	946
"	-124	°F	996
"	-125	°F	1015
" East	-126	°F	1029

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	999
	139	°F	1041
	140	°F	—
to	141	°F	1054
	142	°F	1045
East	143	°F	1037
Top Convection South end	244	°F	401
Bottom Convection Section	248	FF	1196
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.65
Gas Header Press.		psig	10
Draft Gages	--	--	—
Firebox East/WEST	--	inches water	-.64/-.64
Ref. Heaters South stack below Dampers	—	inches water	-.13
Ref. Heaters South Stack above Dampers	--	inches water	-.48
Conv. sect. upper between 100/101	—	inches water	-.2
Conv. sect. center between 100/101	—	inches water	-.2
Conv. sect. lower between 100/101	—	inches water	-.2

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-1 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			1032
H-100 Temperature	TR-201-H100	°F	927
Reformer Charge	FR-303	1000 BBLD	12
H-100 Outlet Temp	TIC-201	°F	927
Stack O_2		%	0/5
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-110	°F	1257
Firebox, east	-111	°F	1217
STEAM FLOW		#/HR $\times 10^3$	37
STEAM PRESS/TEMP			-/448
Heaters outlet	-114	°F	927
tubeskin West	-115	°F	998
"	-116	°F	1021
"	-117	°F	1066
"	-118	°F	1056
"	-119	°F	1012
" to	-120	°F	984
"	-121	°F	—
"	-122	°F	921
"	-123	°F	951
"	-124	°F	998
"	-125	°F	1009
" East	-126	°F	1030

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1023
	139	°F	1065
	140	°F	—
to	141	°F	1061
	142	°F	1044
East	143	°F	1035
Top Convection South end	244	°F	401
Bottom Convection Section	248	FF	1199
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.65
Gas Header Press.		psig	10
Draft Gages	--	--	--
Firebox East / WEST	--	inches water	-.62 / -.62
Ref. Heaters South stack below Dampers	—	inches water	-.12
Ref. Heaters South Stack above Dampers	—	inches water	-.47
Conv. sect. upper between 100/101	—	inches water	-.16
Conv. sect. center between 100/101	—	inches water	-.20
Conv. sect. lower between 100/101	—	inches water	-.17

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-1 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			1103
H-100 Temperature	TR-201-H100	°F	927
Reformer Charge	FR-303	1000 BBLD	12
H-100 Outlet Temp	TIC-201	°F	927
Stack O_2		%	6.0
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-110	°F	1257
Firebox, east	-111	°F	1223
STEAM FLOW		#/HR $\times 10^3$	37
STEAM TEMP		°F	451
Heaters outlet	-114	°F	926
tubeskin West	-115	°F	998
"	-116	°F	1027
"	-117	°F	1065
"	-118	°F	1049
"	-119	°F	1003
" to	-120	°F	977
"	-121	°F	—
"	-122	°F	915
"	-123	°F	943
"	-124	°F	999
"	-125	°F	1013
" East	-126	°F	1031

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1030
	139	°F	1064
	140	°F	—
to	141	°F	1064
	142	°F	1050
East	143	°F	1044
Top Convection South end	244	°F	400
Bottom Convection Section	248	FF	1197
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.65
Gas Header Press.		psig	10
Draft Gages	—	—	—
Firebox East/WEST	—	inches water	-.65/-.65
Ref. Heaters South stack below Dampers	—	inches water	-.12
Ref. Heaters South Stack above Dampers	—	inches water	-.47
Conv. sect. upper between 100/101	—	inches water	-.17
Conv. sect. center between 100/101	—	inches water	-.20
Conv. sect. lower between 100/101	—	inches water	-.20

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-2 LOW LOAD Unit No. 1

Parameter	Meter No.	Units	Readings
Time			1200
H-100 Temperature	TR-201-H100	°F	925
Reformer Charge	FR-303	1000 BBLD	10.0
H-100 Outlet Temp	TIC-201	°F	925
Stack O_2		%	6.95
Reformer Charge B-100B, E-100D	FIC-301,302	1000 BBLD	5.0/5.0
Firebox, west	TI-1-110	°F	1237
Firebox, east	-111	°F	1200
STEAM FLOW		#/HR $\times 10^3$	34.8
STEAM TEMP	253	°F	451
Heaters outlet	-114	°F	925
tubeskin West	-115	°F	993
"	-116	°F	1013
"	-117	°F	1054
"	-118	°F	1044
"	-119	°F	1001
" to	-120	°F	990
"	-121	°F	—
"	-122	°F	921
"	-123	°F	946
"	-124	°F	994
"	-125	°F	1001
" East	-126	°F	1022

SAME BURNERS IN SERVICE AS TEST 5-1

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1045
	139	°F	1054
	140	°F	—
to	141	°F	1041
	142	°F	1023
East	143	°F	1016
Top Convection South end	244	°F	400
Bottom Convection Section	248	°F	1184
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.6
Gas Header Press.		psig	9.3
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.62/-.65
Ref. Heaters South stack below Dampers	--	inches water	-.12
Ref. Heaters South Stack above Dampers	--	inches water	-.47
Conv. sect. upper between 100/101	--	inches water	-.20
Conv. sect. center between 100/101	--	inches water	-.21
Conv. sect. lower between 100/101	--	inches water	-.20

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-2 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			1232
H-100 Temperature	TR-201-H100	°F	925
Reformer Charge	FR-303	1000 BBLD	10.0
H-100 Outlet Temp	TIC-201	°F	925
Stack O_2		%	6.7
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	5/5
Firebox, west	TI-1-110	°F	1239
Firebox, east	-111	°F	1205
STEAM FLOW			34.8
STEAM TEMP			451
Heaters outlet	-114	°F	925
tubeskin West	-115	°F	994
"	-116	°F	1015
"	-117	°F	1059
"	-118	°F	1042
"	-119	°F	1003
" to	-120	°F	978
"	-121	°F	—
"	-122	°F	915
"	-123	°F	938
"	-124	°F	999
"	-125	°F	1006
" East	-126	°F	1014

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1026
	139	°F	1052
	140	°F	—
to	141	°F	1047
	142	°F	1031
East	143	°F	1017
Top Convection South end	244	°F	400
Bottom Convection Section	248	FF	396
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.6
Gas Header Press.		psig	9.0
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.64/-.65
Ref. Heaters South stack below Dampers	—	inches water	-.16
Ref. Heaters South Stack above Dampers	—	inches water	-.48
Conv. sect. upper between 100/101	—	inches water	-.2
Conv. sect. center between 100/101	—	inches water	-.2
Conv. sect. lower between 100/101	—	inches water	-.18

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-2 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			1307
H-100 Temperature	TR-201-H100	°F	925
Reformer Charge	FR-303	1000 BBLD	10.0
H-100 Outlet Temp	TIC-201	°F	925
Stack O_2		%	6.7
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	5/5
Firebox, west	TI-1-110	°F	1237
Firebox, east	-111	°F	1199
STEAM TEMP			451
STEAM FLOW			34.2
Heaters outlet	-114	°F	925
tubeskin West	-115	°F	994
"	-116	°F	1009
"	-117	°F	1050
"	-118	°F	1043
"	-119	°F	999
" to	-120	°F	981
"	-121	°F	—
"	-122	°F	918
"	-123	°F	948
"	-124	°F	994
"	-125	°F	1003
" East	-126	°F	1017

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1041
	139	°F	1059
	140	°F	—
to	141	°F	1049
	142	°F	1037
East	143	°F	1026
Top Convection South end	244	°F	400
Bottom Convection Section	248	PF	1182
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.60
Gas Header Press.		psig	9.0
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.64/-.65
Ref. Heaters South stack below Dampers	—	inches water	-.15
Ref. Heaters South Stack above Dampers	—	inches water	-.50
Conv. sect. upper between 100/101	—	inches water	-.20
Conv. sect. center between 100/101	—	inches water	-.20
Conv. sect. lower between 100/101	—	inches water	-.19

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-2 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			1330
H-100 Temperature	TR-201-H100	°F	925
Reformer Charge	FR-303	1000 BBLD	10.0
H-100 Outlet Temp	TIC-201	°F	925
Stack O_2		%	6.85
Reformer Charge H-100B, H-100D	FIC-301,302	1000 BBLD	5.0/5.0
Firebox, west	TI-1-110	°F	1241
Firebox, east	-111	°F	1206
STEAM FLOW			36
STEAM TEMP			451
Heaters outlet	-114	°F	927
tubeskin West	-115	°F	994
"	-116	°F	1016
"	-117	°F	1061
"	-118	°F	1054
"	-119	°F	1002
" to	-120	°F	981
"	-121	°F	0/5
"	-122	°F	920
"	-123	°F	948
"	-124	°F	1,003
"	-125	°F	1007
" East	-126	°F	1024

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1037
	139	°F	1044
	140	°F	0/5
to	141	°F	1048
	142	°F	1035
East	143	°F	1024
Top Convection South end	244	°F	400
Bottom Convection Section	248	°F	1187
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.6
Gas Header Press.		psig	9.0
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.64/-.63
Ref. Heaters South stack below Dampers	--	inches water	-.14
Ref. Heaters South Stack above Dampers	--	inches water	-.45
Conv. sect. upper between 100/101	--	inches water	-.20
Conv. sect. center between 100/101	--	inches water	-.20
Conv. sect. lower between 100/101	--	inches water	-.20

Location 5

Control Room Data Sheet

Date 6-2-76

Test No. 5-2 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			1400
H-100 Temperature	TR-201-H100	°F	925
Reformer Charge	FR-303	1000 BBLD	10.0
H-100 Outlet Temp	TIC-201	°F	925
Stack O_2		%	6.7
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	5/5
Firebox, west	TI-1-110	°F	1238
Firebox, east	-111	°F	1206
STEAM FLOW			34.2
STEAM TEMP.			351
Heaters outlet	-114	°F	925
tubeskin West	-115	°F	994
"	-116	°F	1016
"	-117	°F	1050
"	-118	°F	1041
"	-119	°F	999
" to	-120	°F	988
"	-121	°F	—
"	-122	°F	922
"	-123	°F	950
"	-124	°F	998
"	-125	°F	1002
" East	-126	°F	1028

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	995
	139	°F	1032
	140	°F	—
to	141	°F	1055
	142	°F	1039
East	143	°F	1025
Top Convection South end	244	°F	400
Bottom Convection Section	248	PF	1181
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.6
Gas Header Press.		psig	9.2
Draft Gages	--	--	--
Firebox East/WEST	—	inches water	-.64/-.64
Ref. Heaters South stack below Dampers	—	inches water	-.16
Ref. Heaters South Stack above Dampers	—	inches water	-.51
Conv. sect. upper between 100/101	—	inches water	-.19
Conv. sect. center between 100/101	—	inches water	-.21
Conv. sect. lower between 100/101	—	inches water	-.19

Location 5

Control Room Data Sheet

Date 6-3-76

Test No. 5-3 Unit No. 1

HIGH LOAD

Parameter	Meter No.	Units	Readings
Time			10:00
H-100 Temperature	TR-201-H100	°F	929
Reformer Charge	FR-303	1000 BBLD	14
H-100 Outlet Temp	TIC-201	°F	929
Stack O_2		%	4.3
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-110	°F	1282
Firebox, east	-111	°F	1246
STEAM FLOW			39 K
STEAM TEMP	253		452
Heaters outlet	-114	°F	929
tubeskin West	-115	°F	1011
"	-116	°F	1028
"	-117	°F	1072
"	-118	°F	1063
"	-119	°F	1011
" to	-120	°F	995
"	-121	°F	—
"	-122	°F	918
"	-123	°F	958
"	-124	°F	1005
"	-125	°F	1022
" East	-126	°F	1035

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1026
	139	°F	1064
	140	°F	—
to	141	°F	1053
	142	°F	1032
East	143	°F	1021
Top Convection South end	244	°F	406
Bottom Convection Section	248	PF	.1219
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.8
Gas Header Press.		psig	11.5
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.63/-.63
Ref. Heaters South stack below Dampers	--	inches water	-.13
Ref. Heaters South Stack above Dampers	--	inches water	-.47
Conv. sect. upper between 100/101	--	inches water	-.17
Conv. sect. center between 100/101	--	inches water	-.17
Conv. sect. lower between 100/101	--	inches water	-.17

Location 5

Control Room Data Sheet

Date 6-3-76

Test No. 5-3 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			10:30
H-100 Temperature	TR-201-H100	°F	929
Reformer Charge	FR-303	1000 BBLD	14
H-100 Outlet Temp	TIC-201	°F	929
Stack O_2		%	4.4
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-110	°F	1282
Firebox, east	-111	°F	1245
STEAM FLOW			39 K
STEAM TEMP.	-253		452
Heaters outlet	-114	°F	929
tubeskin West	-115	°F	1009
"	-116	°F	1028
"	-117	°F	1069
"	-118	°F	1060
"	-119	°F	1014
" to	-120	°F	983
"	-121	°F	—
"	-122	°F	929
"	-123	°F	969
"	-124	°F	1006
"	-125	°F	1016
" East	-126	°F	1045

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1046
	139	°F	1074
	140	°F	—
to	141	°F	1052
	142	°F	1027
East	143	°F	1019
Top Convection South end	244	°F	405
Bottom Convection Section	248	PF	1222
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.8
Gas Header Press.		psig	11.4
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.62/-.64
Ref. Heaters South stack below Dampers	--	inches water	-.14
Ref. Heaters South Stack above Dampers	--	inches water	-.48
Conv. sect. upper between 100/101	--	inches water	-.18
Conv. sect. center between 100/101	--	inches water	-.18
Conv. sect. lower between 100/101	--	inches water	-.17

Location 5

Control Room Data Sheet

Date 6-3-76

Test No. 5-3 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			11:00
H-100 Temperature	TR-201-H100	°F	930
Reformer Charge	FR-303	1000 BBLD	14
H-100 Outlet Temp	TIC-201	°F	930
Stack O_2		%	4.4
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-110	°F	1283
Firebox, east	-111	°F	1246
STEAM FLOW			39.6
STEAM TEMP			451
Heaters outlet	-114	°F	930
tubeskin West	-115	°F	1009
"	-116	°F	1027
"	-117	°F	1073
"	-118	°F	1059
"	-119	°F	1010
" to	-120	°F	982
"	-121	°F	—
"	-122	°F	923
"	-123	°F	955
"	-124	°F	1005
"	-125	°F	1018
" East	-126	°F	1047

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1042
	139	°F	1068
	140	°F	–
to	141	°F	1045
	142	°F	1024
East	143	°F	1016
Top Convection South end	244	°F	406
Bottom Convection Section	248	FF	1221
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.8
Gas Header Press.		psig	11.7
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.64 / -.65
Ref. Heaters South stack below Dampers	--	inches water	-.14
Ref. Heaters South Stack above Dampers	--	inches water	-.5
Conv. sect. upper between 100/101	--	inches water	-.17
Conv. sect. center between 100/101	--	inches water	-.19
Conv. sect. lower between 100/101	--	inches water	-.18

Location 5

Control Room Data Sheet

Date 6-3-76

Test No. 5-3 Unit No. 1

Parameter	Meter No.	Units	Readings
Time			11:30
H-100 Temperature	TR-201-H100	°F	928
Reformer Charge	FR-303	1000 BBLD	14
H-100 Outlet Temp	TIC-201	°F	928
Stack O_2		%	4.35
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-110	°F	1280
Firebox, east	-111	°F	1246
STEAM FLOW			.39
STEAM TEMP.			451
Heaters outlet	-114	°F	928
tubeskin West	-115	°F	1005
"	-116	°F	1033
"	-117	°F	1080
"	-118	°F	1054
"	-119	°F	1006
" to	-120	°F	980
"	-121	°F	—
"	-122	°F	926
"	-123	°F	954
"	-124	°F	1005
"	-125	°F	1016
" East	-126	°F	1037

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1038
	139	°F	1058
	140	°F	—
to	141	°F	1058
	142	°F	1027
East	143	°F	1024
Top Convection South end	244	°F	405
Bottom Convection Section	248	°F	1218
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.8
Gas Header Press.		psig	11.5
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.6/-.63
Ref. Heaters South stack below Dampers	—	inches water	-.12
Ref. Heaters South Stack above Dampers	—	inches water	-.5
Conv. sect. upper between 100/101	—	inches water	-.2
Conv. sect. center between 100/101	—	inches water	-.2
Conv. sect. lower between 100/101	—	inches water	-.18

Location 5

Control Room Data Sheet

Date 6-3-76

Test No. 5-4 BASELINE Unit No. 1

Parameter	Meter No.	Units	Readings
Time			12:45
H-100 Temperature	TR-201-H100	°F	927
Reformer Charge	FR-303	1000 BBLD	12
H-100 Outlet Temp	TIC-201	°F	927
Stack O_2		%	6.15
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6 / 6
Firebox, west	TI-1-110	°F	1257
Firebox, east	-111	°F	1239
STEAM FLOW			8.4
STEAM TEMP.			450
Heaters outlet	-114	°F	927
tubeskin West	-115	°F	994
"	-116	°F	1011
"	-117	°F	1054
"	-118	°F	1050
"	-119	°F	1008
" to	-120	°F	983
"	-121	°F	—
"	-122	°F	925
"	-123	°F	957
"	-124	°F	999
"	-125	°F	1018
" East	-126	°F	1034

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1035
	139	°F	1059
	140	°F	—
to	141	°F	1051
	142	°F	1027
East	143	°F	1013
Top Convection South end	244	°F	405
Bottom Convection Section	248	FF	1207
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.7
Gas Header Press.		psig	10.5
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.64/-.61
Ref. Heaters South stack below Dampers	--	inches water	-.14
Ref. Heaters South Stack above Dampers	--	inches water	-.5
Conv. sect. upper between 100/101	--	inches water	-.2
Conv. sect. center between 100/101	--	inches water	-.2
Conv. sect. lower between 100/101	--	inches water	-.19

Location 5

Control Room Data Sheet

Date 6-3-76

Test No. 5-4 Unit No. 1

REGISTER ADJUSTMENT

Parameter	Meter No.	Units	Readings
Time			13:20
H-100 Temperature	TR-201-H100	°F	925
Reformer Charge	FR-303	1000 BBLD	12
H-100 Outlet Temp	TIC-201	°F	925
Stack O_2		%	11.5
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-110	°F	1273
Firebox, east	-111	°F	1293
STEAM FLOW		#/HR x 10^3	44.4
STEAM TEMP	253	°F	451
Heaters outlet	-114	°F	925
tubeskin West	-115	°F	1010
"	-116	°F	1018
"	-117	°F	1061
"	-118	°F	1092
"	-119	°F	998
" to	-120	°F	992
"	-121	°F	—
"	-122	°F	912
"	-123	°F	951
"	-124	°F	1013
"	-125	°F	999
" East	-126	°F	1015

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1011
	139	°F	1041
	140	°F	—
to	141	°F	1050
	142	°F	1027
East	143	°F	1021
Top Convection South end	244	°F	490
Bottom Convection Section	248	FF	1186
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	3.4
Gas Header Press.		psig	16.6
Draft Gages	—	—	—
Firebox East/WEST	—	inches water	-.14/-.15
Ref. Heaters South stack below Dampers	—	inches water	+.03
Ref. Heaters South Stack above Dampers	—	inches water	-.51
Conv. sect. upper between 100/101	—	inches water	0
Conv. sect. center between 100/101	—	inches water	0
Conv. sect. lower between 100/101	—	inches water	0

Location 5

Control Room Data Sheet

Date 6-3-76

Test No. 5-4
5/1-4c

Unit No. 1

Parameter	Meter No.	Units	Readings
Time			13:50
H-100 Temperature	TR-201-H100	°F	927
Reformer Charge	FR-303	1000 BBLD	12
H-100 Outlet Temp	TIC-201	°F	927
Stack O_2		%	11.4
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6 / 6
Firebox, west	TI-1-110	°F	1269
Firebox, east	-111	°F	1195
STEAM FLOW			(4.4) ? 44.4?
STEAM TEMP			451
Heaters outlet	-114	°F	928
tubeskin West	-115	°F	1019
"	-116	°F	1015
"	-117	°F	1052
"	-118	°F	1076
"	-119	°F	1008
" to	-120	°F	993
"	-121	°F	—
"	-122	°F	930
"	-123	°F	968
"	-124	°F	1011
"	-125	°F	1006
" East	-126	°F	1031

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1024
	139	°F	1059
	140	°F	—
to	141	°F	1046
	142	°F	1022
East	143	°F	1010
Top Convection South end	244	°F	427
Bottom Convection Section	248	FF	1197
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	3.2
Gas Header Press.		psig	15
Draft Gages	--	--	--
Firebox East/WEST	--	inches water	-.45/-.45
Ref. Heaters South stack below Dampers	—	inches water	-.03
Ref. Heaters South Stack above Dampers	—	inches water	-.51
Conv. sect. upper between 100/101	—	inches water	-.05
Conv. sect. center between 100/101	—	inches water	-.05
Conv. sect. lower between 100/101	—	inches water	-.05

Location 5

Control Room Data Sheet

Date 6-3-76

Test No. 5-4 Unit No. 1

BURNER PATTERN - 8 BURNERS

Parameter	Meter No.	Units	Readings
Time			15:10
H-100 Temperature	TR-201-H100	°F	928
Reformer Charge	FR-303	1000 BBLD	12
H-100 Outlet Temp	TIC-201	°F	928
Stack O_2		%	6.95
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-110	°F	1304
Firebox, east	-111	°F	1288
STEAM FLOW			49.4
STEAM TEMP.			451
Heaters outlet	-114	°F	927
tubeskin West	-115	°F	983
"	-116	°F	974
"	-117	°F	983
"	-118	°F	1013
"	-119	°F	1038
" to	-120	°F	1033
"	-121	°F	—
"	-122	°F	992
"	-123	°F	975
"	-124	°F	956
"	-125	°F	962
" East	-126	°F	1011

Parameter	Meter No.	Units	Readings
Tubeskin West	TI-1-138	°F	1022
	139	°F	1052
	140	°F	—
to	141	°F	1048
	142	°F	1021
East	143	°F	1013
Top Convection South end	244	°F	419
Bottom Convection Section	248	FF	1038
Gas Flow to Unit 100 x 348	FT-201	SCFD x 10^3	2.95
Gas Header Press.		psig	7.1
Draft Gages	—	--	--
Firebox East/WEST	--	inches water	-.55/-.56
Ref. Heaters South stack below Dampers	--	inches water	-.11
Ref. Heaters South Stack above Dampers	--	inches water	-.49
Conv. sect. upper between 100/101	--	inches water	-.15
Conv. sect. center between 100/101	--	inches water	-.15
Conv. sect. lower between 100/101	--	inches water	-.16

LOCATION 5

GAS CHROMATOGRAPHIC ANALYSIS

	5/1-1	5/1-2	5/1-3
Oxygen	0.03	0.02	0.06
Nitrogen (by difference)	2.07	1.11	1.40
Carbon Dioxide	0.31	1.02	0.67
Carbon Monoxide	0.11	0.071	0.10
Hydrogen	8.70	7.62	10.03
Methane (by difference)	47.18	56.76	46.78
Ethane	7.2 8	6.63	8.12
Ethylene	0.06	0.05	0.06
Total C3	17.6	14.9	18.0
Total C4	14.5	10.3	12.9
Total C5	1.93	1.34	1.53
Total C6	0.23	0.18	0.35
Heating Value (BTU dry/SCF)	1645	1495	1606

PROCESS HEATER DESIGN DATA

Location No. 5 Unit No. 2

Unit Description THE HEATER IS A VERTICALLY FIRED NATURAL DRAFT PROCESS HEATER EQUIPPED WITH 10 FLOOR MOUNTED BURNERS IN A SINGLE LINE.

Installation Date	1974
Burner Description	10 COMBINATION OIL/GAS BURNERS
Test Fuel	REFINERY GAS
Fuel Temp. at Burner (°F)	AMBIENT
Primary Air Temp. (°F)	AMBIENT
Heater Rating	34.6×10^6 BTU/HR

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 5 Date_____ Location 5 Engr._____

Unit No. 1 Fuel_____ Capacity_____

Unit Type REF. HTR. Burner Type_____

1. Test No.	5/2-1		5/2-1		5/2-1		5/2-1		5/2-2	
2. Date	6-4-76		6-4-76		6-4-76		6-4-76		6-4-76	
3. Time	1030		1100		1130		1200		1235	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	3.9		4.0		3.9		3.8		2.1	
9. NOx (hot) read/3% O_2 (ppm)*	65	68	67	71	66	69	64	67	48	46
10. NO (hot) read/3% O_2 (ppm)*	65	68	66	70	66	69	64	67	48	46
11. NO_2 (hot) read/3% O_2 (ppm)*	0	0	1	1	0	0	0	0	0	0
12. NO (cold) read/3% O_2 (ppm)*	72	76	73	77	74	78	71	74	58	55
13. Carbon Dioxide (%)	10.4		10.3		10.6		10.6		12.0	
14. Carbon Monoxide (ppm) uncor/cor*	10	11	10	11	10	11	8	8	10	10
15. Hydrocarbon (ppm) uncor/cor*	1	1	2	2	1	1	1	1	1	1
16. Sulfur Dioxide (ppm) uncor/cor*	4	4	3	3	2	2	2	2	2	2
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)			78		76		76		75	
19. Dew Point Temp. (°F/°C)			62		63		63		63	
20. Atmos. Pressure (in. Hg)	29.98		29.98		29.97		29.97		29.98	
21. Relative Humidity (%)			41		49		49		52	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date 6-4-76 Location 5 Engr._____

Unit No. 1 Fuel GAS Capacity_____

Unit Type REF. HEATER Burner Type_____

1. Test No.	5/2-2		5/2-2		5/2-2		5/2-3									
2. Date	6-4-76		6-4-76		6-4-76		6-4-76									
3. Time	1300		1330		1400		1430									
4. Load																
5. Process Rate																
6. Flue Diam. or Size, ft																
7. Probe Position																
8. Oxygen (%)	2.0		2.6		2.4		4.1									
9. NOx (hot) read/3% O_2 (ppm)*	44	42	50	49	46	45	59	63								
10. NO (hot) read/3% O_2 (ppm)*	42	40	48	47	44	43	58	62								
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	2	2	2	2	1	1								
12. NO (cold) read/3% O_2 (ppm)*	58	55	62	61	62	60	71	76								
13. Carbon Dioxide (%)	11.7		12.0		12.0		10.8									
14. Carbon Monoxide (ppm) uncor/cor*	8	8	8	8	8	8	10	11								
15. Hydrocarbon (ppm) uncor/cor*	1	1	1	1	1	1	1	1								
16. Sulfur Dioxide (ppm) uncor/cor*	2	2	2	2	2	2	2	2								
17. Smoke Spot (Bacharach)																
18. Atmos. Temp. (°F/°C)	76		76		74		76									
19. Dew Point Temp. (°F/°C)	64		64		65		65									
20. Atmos. Pressure (in. Hg)	29.98		29.98		29.98		29.97									
21. Relative Humidity (%)	52		52		63		56									
22.																
23.																
24.																
25.																
26.																
27.																
28.																
29.																
30.																

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date 6/7/76 Location 5 Engr._____

Unit No. 1 Fuel GAS Capacity_____

Unit Type PROCESS HEATER Burner Type JOHN ZINK

1. Test No.	5/2-4		5/2-5		5/2-5		5/2-5		5/2-5	
2. Date	6-7-76		6-7-76		6-7-76		6-7-76		6-7-76	
3. Time	1000		1100		1130		1200		1230	
4. Load	NORMAL		LOW		LOW		LOW		LOW	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	3.5		5.3		5.2		5.1		5.0	
9. NOx (hot) read/3% O_2 (ppm)*	66	68	78	89	79	90	77	87	79	89
10. NO (hot) read/3% O_2 (ppm)*	64	66	78	89	78	89	77	87	78	88
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	0	0	1	1	0	0	1	1
12. NO (cold) read/3% O_2 (ppm)*	73	75	89	102	92	105	86	97	87	98
13. Carbon Dioxide (%)	10.8		9.9		9.9		10.0		9.6	
14. Carbon Monoxide (ppm) uncor/cor*	12	12	11	13	11	13	10	11	12	14
15. Hydrocarbon (ppm) uncor/cor*	2	2	0	0	0	0	2	2	1	1
16. Sulfur Dioxide (ppm) uncor/cor*	5	5	4	5	5	6	5	6	6	7
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	71		74		74		74		73	
19. Dew Point Temp. (°F/°C)	62		63		63		64		65	
20. Atmos. Pressure (in. Hg)	29.94		29.94		29.94		29.95		29.95	
21. Relative Humidity (%)	61		55		55		59		66	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No._____ Date 6/7/76 Location 5 Engr._____

Unit No. 1 Fuel GAS Capacity_____

Unit Type PROCESS HEATER Burner Type JOHN ZINK

1. Test No.	5/2-6		5/2-7								
2. Date	6-7-76		6-7-76								
3. Time	1345		1420								
4. Load											
5. Process Rate	14 K lb/d		14 K lb/d								
6. Flue Diam. or Size, ft											
7. Probe Position											
8. Oxygen (%)	1.9		4.0								
9. NOx (hot) read/3% O_2 (ppm)*	58	55	54	57							
10. NO (hot) read/3% O_2 (ppm)*	55	52	52	55							
11. NO_2 (hot) read/3% O_2 (ppm)*	3	3	2	2							
12. NO (cold) read/3% O_2 (ppm)*	62	58	58	61							
13. Carbon Dioxide (%)	12		10.2								
14. Carbon Monoxide (ppm) uncor/cor*	15	14	12	13							
15. Hydrocarbon (ppm) uncor/cor*	1	1	1	1							
16. Sulfur Dioxide (ppm) uncor/cor*	9	8	8	8.5							
17. Smoke Spot (Bacharach)											
18. Atmos. Temp. (°F/°C)	74		74								
19. Dew Point Temp. (°F/°C)	64		64								
20. Atmos. Pressure (in. Hg)	29.94		29.92								
21. Relative Humidity (%)	58		58								
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

Location 5

Control Room Data Sheet

Date 6-4

Test No. 5/2-1 Unit No. 2

BASELINE/NORM. LOAD

Parameter	Meter No.	Units	Readings
Time			10:30
B-102 Temperature	TR-203-H102	°F	928
Reformer Charge	FR-303	1000 BBLD	12.0
B-102 Outlet Temp	TIC-203	°F	928
Stack O_2		%	4.85
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-144	°F	1403
Firebox, east	-145	°F	1342
Steam Flow	FR-505	#/hr x 10^3	40.2
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	928
Tubeskin west	-149	°F	1056
"	-150	°F	1019
" to	-151	°F	982
"	-152	°F	986
" east	-153	°F	986
Reformer Heaters north/south stack	243/242	°F	407 / 423
Top Convection north center	245	°F	406
Bottom Convection Section	250	°F	1184

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.6
Gas Header Press.		psig	9.0
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.65 / -.65
Ref. Heaters South stack below Dampers	--	inches water	-.15
Ref. Heaters South stack above Dampers	--	inches water	-.5
Conv. sect. upper between 101/102	--	inches water	-.24
Conv. sect. lower between 101/102	--	inches water	-.25

Location 5

Control Room Data Sheet

Date 6-4-76

Test No. 5/2-1 Unit No. 2

Parameter	Meter No.	Units	Readings
Time			11:00
H-102 Temperature	TR-203-H102	°F	927
Reformer Charge	FR-303	1000 BBLD	12
H-102 Outlet Temp	TIC-203	°F	927
Stack O_2		%	5.4
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-144	°F	1402
Firebox, east	-145	°F	1319
Steam Flow	FR-505	#/hr x 10^3	39.6
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	927
Tubeskin west	-149	°F	1047
"	-150	°F	1014
" to	-151	°F	979
"	-152	°F	991
" east	-153	°F	993
Reformer Heaters north/south stack	243/242	°F	407/422
Top Convection north center	245	°F	406
Bottom Convection Section	250	°F	1180

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.6
Gas Header Press.		psig	9.5
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.66 / -.66
Ref. Heaters South stack below Dampers	--	inches water	-.14
Ref. Heaters South stack above Dampers	--	inches water	-.51
Conv. sect. upper between 101/102	--	inches water	-.25
Conv. sect. lower between 101/102	--	inches water	-.25

Location 5

Control Room Data Sheet

Date 6-4-76

Test No. 512-1 Unit No. 2

Parameter	Meter No.	Units	Readings
Time			11:30
B-102 Temperature	TR-203-H102	°F	928
Reformer Charge	FR-303	1000 BBLD	12
B-102 Outlet Temp	TIC-203	°F	928
Stack O_2		%	5.0
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-144	°F	1402
Firebox, east	-145	°F	1320
Steam Flow	FR-505	#/hr x 10^3	39.6
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	928
Tubeskin west	-149	°F	1051
"	-150	°F	1020
" to	-151	°F	968
"	-152	°F	974
" east	-153	°F	1005
Raformer Heaters north/south stack	243/242	°F	407/422
Top Convection north center	245	°F	406
Bottom Convection Section	250	°F	1177

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.6
Gas Header Press.		psig	9
Draft Gages	--	--	--
Firebox east/west	--	inches water	.67 / -.68
Ref. Heaters South stack below Dampers	--	inches water	-.14
Ref. Heaters South stack above Dampers	--	inches water	-.5
Conv. sect. upper between 101/102	--	inches water	-.23
Conv. sect. lower between 101/102	--	inches water	-.24

Location 5

Control Room Data Sheet

Date 6-4-76

Test No. 512-1 Unit No. 2

Parameter	Meter No.	Units	Readings
Time			12:00
B-102 Temperature	TR-203-H102	°F	928
Reformer Charge	FR-303	1000 BBLD	12
B-102 Outlet Temp	TIC-203	°F	928
Stack O_2		%	4.9
Reformer Charge B-100B, B-100D	FIC-301,302	1000 BBLD	616
Firebox, west	TI-1-144	°F	1402
Firebox, east	-145	°F	1340
Steam Flow	FR-505	#/hr x 10^3	39
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	928
Tubeskin west	-149	°F	1050
"	-150	°F	1016
" to	-151	°F	985
"	-152	°F	990
" east	-153	°F	987
Reformer Heaters north/south stack	241/242	°F	406 / 422
Top Convection north center	245	°F	406
Bottom Convection Section	250	°F	1180

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.6
Gas Header Press.		psig	9
Draft Gages	--	--	-
Firebox east/west	--	inches water	.67 / .67
Raf. Heaters South stack below Dampers	--	inches water	-.14
Raf. Heaters South stack above Dampers	--	inches water	-.5
Conv. sect. upper between 101/102	--	inches water	-.24
Conv. sect. lower between 101/102	--	inches water	-.24

Location 5

Control Room Data Sheet

Date 6-4-76

Test No. 5/2-2 Unit No. 2

HIGH LOAD

Parameter	Meter No.	Units	Readings
Time			12:35
B-102 Temperature	TR-203-H102	°F	930
Reformer Charge	FR-303	1000 BBLD	14
B-102 Outlet Temp	TIC-203	°F	930
Stack O_2		%	2-8
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-144	°F	1442
Firebox, east	-145	°F	1365
Steam Flow	FR-505	#/hr x 10^3	41.4
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	929
Tubeskin west	-149	°F	1072
"	-150	°F	1035
" to	-151	°F	985
"	-152	°F	996
" east	-153	°F	1002
Reformer Heaters north/south stack	243/242	°F	408/422
Top Convection north center	245	°F	407
Bottom Convection Section	250	°F	1201

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.85
Gas Header Press.		psig	11.0
Draft Gages	--	--	--
Firebox east/west	—	inches water	-.65 / -.64
Ref. Heaters South stack below Dampers	--	inches water	-.12
Ref. Heaters South stack above Dampers	—	inches water	-.5
Conv. sect. upper between 101/102	—	inches water	-.22
Conv. sect. lower between 101/102	—	inches water	-.21

Location 5

Control Room Data Sheet

Date 6-4-76

Test No. 512-2 Unit No. 2

Parameter	Meter No.	Units	Readings
Time			13:00
H-102 Temperature	TR-203-H102	°F	929
Reformer Charge	FR-303	1000 BBLD	14
H-102 Outlet Temp	TIC-203	°F	929
Stack O_2		%	2-6
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-144	°F	1446
Firebox, east	-145	°F	1355
Steam Flow	FR-505	#/hr x 10^3	39.6
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	930
Tubeskin west	-149	°F	1062
"	-150	°F	1020
" to	-151	°F	978
"	-152	°F	993
" east	-153	°F	1013
Reformer Heaters north/south stack	243/242	°F	408/423
Top Convection north center	245	°F	407
Bottom Convection Section	250	°F	1199

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2-85
Gas Header Press.		psig	11
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.65 / -.65
Ref. Heaters South stack below Dampers	--	inches water	-.11
Ref. Heaters South stack above Dampers	--	inches water	-.5
Conv. sect. upper between 101/102	--	inches water	-.21
Conv. sect. lower between 101/102	--	inches water	-.21

Location 5

Control Room Data Sheet

Date 6-4-76

Test No. 5/2-2 Unit No. 2

Parameter	Meter No.	Units	Readings
Time			13:30
H-102 Temperature	TR-203-H102	°F	929
Reformer Charge	FR-303	1000 BBLD	14
H-102 Outlet Temp	TIC-203	°F	929
Stack O_2		%	3.2
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-144	°F	1440
Firebox, east	-145	°F	1353
Steam Flow	FR-505	#/hr x 10^3	40.8
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	929
Tubeskin west	-149	°F	1060
"	-150	°F	1028
" to	-151	°F	986
"	-152	°F	999
" east	-153	°F	1006
Reformer Heaters north/south stack	243/242	°F	405/423
Top Convection north center	245	°F	407
Bottom Convection Section	250	°F	1198

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.85
Gas Header Press.		psig	11
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.69 / -.65
Ref. Heaters South stack below Dampers	--	inches water	-.11
Ref. Heaters South stack above Dampers	--	inches water	-.5
Conv. sect. upper between 101/102	--	inches water	-.21
Conv. sect. lower between 101/102	--	inches water	-.21

Location 5

Control Room Data Sheet

Date 6-4-76

Test No. 5/2-2 Unit No. 2

Parameter	Meter No.	Units	Readings
Time			14:00
H-102 Temperature	TR-203-H102	°F	929
Reformer Charge	FR-303	1000 BBLD	14
H-102 Outlet Temp	TIC-203	°F	929
Stack O_2		%	3.0
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-144	°F	1442
Firebox, east	-145	°F	1352
Steam Flow	FR-505	#/hr x 10^3	41.4
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	929
Tubeskin west	-149	°F	1063
"	-150	°F	1028
" to	-151	°F	974
"	-152	°F	984
" east	-153	°F	1012
Reformer Heaters north/south stack	243/242	°F	408/423
Top Convection north center	245	°F	407
Bottom Convection Section	250	°F	1197

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.85
Gas Header Press.		psig	11
Draft Gages	—	—	—
Firebox east/west	—	inches water	-.65 / -.65
Ref. Heaters South stack below Dampers	—	inches water	-.12
Ref. Heaters South stack above Dampers	—	inches water	-.5
Conv. sect. upper between 101/102	—	inches water	-.20
Conv. sect. lower between 101/102	—	inches water	-.21

Location 5

Control Room Data Sheet

Date 6-4-76

Test No. 512-3 Unit No. 2

BASELINE CHECK

Parameter	Meter No.	Units	Readings
Time			14:30
B-102 Temperature	TR-203-H102	°F	929
Reformer Charge	FR-303	1000 BBLD	12
B-102 Outlet Temp	TIC-203	°F	929
Stack O_2		%	5-4
Reformer Charge B-100B, B-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-144	°F	1395
Firebox, east	-145	°F	1314
Steam Flow	FR-505	#/hr x 10^3	40.8
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	929
Tubeskin west	-149	°F	1045
"	-150	°F	1014
" to	-151	°F	980
"	-152	°F	982
" east	-153	°F	998
Reformer Heaters north/south stack	243/242	°F	406 / 423
Top Convection north center	245	°F	406
Bottom Convection Section	250	°F	1178

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.7
Gas Header Press.		psig	9.0
Draft Gages	—	—	—
Firebox east/west	—	inches water	-.64 / -.65
Ref. Heaters South stack below Dampers	—	inches water	-.15
Ref. Heaters South stack above Dampers	—	inches water	-.5
Conv. sect. upper between 101/102	—	inches water	-.22
Conv. sect. lower between 101/102	—	inches water	-.23

Location 5

Control Room Data Sheet

Date 6-7-76

Test No. 512-4 Unit No. 2

BASELINE MED. LOAD

Parameter	Meter No.	Units	Readings
Time			10:00
H-102 Temperature	TR-203-H102	°F	930
Reformer Charge	FR-303	1000 BBLD	12
H-102 Outlet Temp	TIC-203	°F	930
Stack O_2		%	4-8
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	6/6
Firebox, west	TI-1-144	°F	1409
Firebox, east	-145	°F	1335
Steam Flow	FR-505	#/hr x 10^3	38.4
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	930
Tubeskin west	-149	°F	1055
"	-150	°F	1016
" to	-151	°F	972
"	-152	°F	976
" east	-153	°F	1001
Reformer Heaters north/south stack	243/242	°F	407/416
Top Convection north center	245	°F	400
Bottom Convection Section	250	°F	1180

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2-6
Gas Header Press.		psig	8-7
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.64 / -.61
Ref. Heaters South stack below Dampers	--	inches water	-.12
Ref. Heaters South stack above Dampers	--	inches water	-.49
Conv. sect. upper between 101/102	--	inches water	-.21
Conv. sect. lower between 101/102	--	inches water	-.21

Location 5

Control Room Data Sheet

Date 6-7-76

Test No. 512-5 Unit No. 2

BASELINE LOW LOAD

Parameter	Meter No.	Units	Readings
Time			11:00
H-102 Temperature	TR-203-H102	°F	927
Reformer Charge	FR-303	1000 BBLD	10
H-102 Outlet Temp	TIC-203	°F	927
Stack O_2		%	7.0
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	5/5
Firebox, west	TI-1-144	°F	1349
Firebox, east	-145	°F	1291
Steam Flow	FR-505	#/hr x 10^3	37.2
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	927
Tubeskin west	-149	°F	1031
"	-150	°F	1001
" to	-151	°F	983
"	-152	°F	982
" east	-153	°F	970
Reformer Heaters north/south stack	243/242	°F	405/414
Top Convection north center	245	°F	398
Bottom Convection Section	250	°F	1163

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.4
Gas Header Press.		psig	6.6
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.63 / -.61
Ref. Heaters South stack below Dampers	--	inches water	-.12
Ref. Heaters South stack above Dampers	--	inches water	-.51
Conv. sect. upper between 101/102	--	inches water	-.22
Conv. sect. lower between 101/102	--	inches water	-.21

Location 5

Control Room Data Sheet

Date 6-7-76

Test No. 512-5 Unit No. 2

Parameter	Meter No.	Units	Readings
Time			11:30
H-102 Temperature	TR-203-H102	°F	927
Reformer Charge	FR-303	1000 BBLD	10
H-102 Outlet Temp	TIC-203	°F	927
Stack O_2		%	6.8
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	5/5
Firebox, west	TI-1-144	°F	1352
Firebox, east	-145	°F	1301
Steam Flow	FR-505	#/hr x 10^3	37.8
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	927
Tubeskin west	-149	°F	1041
"	-150	°F	1010
" to	-151	°F	986
"	-152	°F	971
" east	-153	°F	969
Reformer Heaters north/south stack	243/242	°F	405/414
Top Convection north center	245	°F	398
Bottom Convection Section	250	°F	1165

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	~~6.9~~ 2.4
Gas Header Press.		psig	6.9
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.64 / -.65
Ref. Heaters South stack below Dampers	--	inches water	-.11
Ref. Heaters South stack above Dampers	--	inches water	-.5
Conv. sect. upper between 101/102	--	inches water	-.15
Conv. sect. lower between 101/102	--	inches water	-.17

Location 5

Control Room Data Sheet

Date 6-7-76

Test No. 5/2-5 Unit No. 2

LOW LOAD

Parameter	Meter No.	Units	Readings
Time			12:00
H-102 Temperature	TR-203-H102	°F	927
Reformer Charge	FR-303	1000 BBLD	10
H-102 Outlet Temp	TIC-203	°F	927
Stack O_2		%	6.6
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	5/5
Firebox, west	TI-1-144	°F	1356
Firebox, east	-145	°F	1287
Steam Flow	FR-505	#/hr x 10^3	38.4
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	927
Tubeskin west	-149	°F	1033
"	-150	°F	1007
" to	-151	°F	970
"	-152	°F	974
" east	-153	°F	988
Reformer Heaters north/south stack	243/242	°F	405/414
Top Convection north center	245	°F	398
Bottom Convection Section	250	°F	1162

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.4
Gas Header Press.		psig	7.0
Draft Gages	--	--	--
Firebox east/west	—	inches water	-.62 / -.62
Raf. Heaters South stack below Dampers	--	inches water	-.10
Raf. Heaters South stack above Dampers	—	inches water	-.5
Conv. sect. upper between 101/102	—	inches water	-.21
Conv. sect. lower between 101/102	--	inches water	-.21

Location 5

Control Room Data Sheet

Date 6-7-76

Test No. 5/2-5 Unit No. 2

LOW LOAD

Parameter	Meter No.	Units	Readings
Time			12:30
H-102 Temperature	TR-203-H102	°F	927
Reformer Charge	FR-303	1000 BBLD	10
H-102 Outlet Temp	TIC-203	°F	927
Stack O_2		%	7.8
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	5/5
Firebox, west	TI-1-144	°F	1359
Firebox, east	-145	°F	1280
Steam Flow	FR-505	#/hr x 10^3	38.4
Steam Temp.	-253	°F	451
Heater outlet	-148	°F	927
Tubeskin west	-149	°F	1035
"	-150	°F	1003
" to	-151	°F	969
"	-152	°F	980
" east	-153	°F	988
Reformer Heaters north/south stack	243/242	°F	405/414
Top Convection north center	245	°F	398
Bottom Convection Section	250	°F	1152

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.4
Gas Header Press.		psig	2.0
Draft Gages	--	--	-
Firebox east/west	--	inches water	-.61 / -.61
Ref. Heaters South stack below Dampers	--	inches water	-.11
Ref. Heaters South stack above Dampers	--	inches water	-.5
Conv. sect. upper between 101/102	--	inches water	-.21
Conv. sect. lower between 101/102	--	inches water	-.21

Location 5

Control Room Data Sheet

Date 6-7-76

Test No. 5/2-6 Unit No. 2

HIGH LOAD BASELINE NORM. O_2

Parameter	Meter No.	Units	Readings
Time			13:45
H-102 Temperature	TR-203-H102	°F	930
Reformer Charge	FR-303	1000 BBLD	14
H-102 Outlet Temp	TIC-203	°F	930
Stack O_2		%	2-9
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-144	°F	1443
Firebox, east	-145	°F	1372
Steam Flow	FR-505	#/hr x 10^3	41.4
Steam Temp.	-253	°F	452
Heater outlet	-148	°F	930
Tubeskin west	-149	°F	1071
"	-150	°F	1028
" to	-151	°F	982
"	-152	°F	992
" east	-153	°F	1006
Reformer Heaters north/south stack	243/242	°F	412/420
Top Convection north center	245	°F	405
Bottom Convection Section	250	°F	1202

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2.9
Gas Header Press.		psig	10.7
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.67 / -.66
Ref. Heaters South stack below Dampers	--	inches water	-.16
Ref. Heaters South stack above Dampers	--	inches water	-.53
Conv. sect. upper between 101/102	--	inches water	-.21
Conv. sect. lower between 101/102	--	inches water	-.24

Location 5

Control Room Data Sheet

Date 6-7-76

Test No. 512-7 Unit No. 2

HIGH LOAD ~4% O_2

Parameter	Meter No.	Units	Readings
Time			14:20
B-102 Temperature	TR-203-H102	°F	9:30
Reformer Charge	FR-303	1000 BBLD	14
B-102 Outlet Temp	TIC-203	°F	930
Stack O_2		%	5.5
Reformer Charge E-100B, E-100D	FIC-301,302	1000 BBLD	7/7
Firebox, west	TI-1-144	°F	1453
Firebox, east	-145	°F	1365
Steam Flow	FR-505	#/hr x 10^3	42.0
Steam Temp.	-253	°F	452
Heater outlet	-148	°F	930
Tubeskin west	-149	°F	1054
"	-150	°F	1030
" to	-151	°F	970
"	-152	°F	983
" east	-153	°F	1029
Reformer Heaters north/south stack	243/242	°F	414/422
Top Convection north center	245	°F	407
Bottom Convection Section	250	°F	1186

REGISTER ON #5 BRN. ½ OPEN

Parameter	Meter No.	Units	Readings
Gas Flow to Unit 100 x 197	FT-201	SCFD x 10^3	2-95
Gas Header Press.		psig	11.6
Draft Gages	--	--	--
Firebox east/west	--	inches water	-.63 / -.62
Ref. Heaters South stack below Dampers	--	inches water	-.1
Ref. Heaters South stack above Dampers	--	inches water	-.51
Conv. sect. upper between 101/102	--	inches water	-.2
Conv. sect. lower between 101/102	--	inches water	-.2

LOCATION 5

GAS CHROMATOGRAPHIC ANALYSIS

	5/2-1
Oxygen	0.05
Nitrogen (by difference)	1.15
Carbon Dioxide	1.23
Carbon Monoxide	0.092
Hydrogen	7.40
Methane (by difference)	53.46
Ethane	7.07
Ethylene	0.05
Total C3	16.2
Total C4	11.6
Total C5	1.42
Total C6	0.28
Heating Value (BTU dry/SCF)	1552

ALUMINUM MELTING FURNACE

Location No. 6 Unit No.

Unit Description ALUMINUM MELTING FURNACE
39 Mg (43 TONS)

Installation Date

Heater Rating 10.6 MW (36 x 10^6 Btu/hr)

Burner Description 2 COMBINATION GAS - OIL BURNERS
NORTH AMERICAN BURNER MODEL G1351-D2-16.8

Test Fuel Combinations NAT. GAS
No 2 OIL (0.25% SULFUR)

Fuel Temp. at Burner (°F) ATMOSPHERIC.

Primary Air Temp. (°F) ATMOSPHERIC.

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 6 Date 6-28-76 Location 6 Engr._____

Unit No._____ Fuel N. G. Capacity 43 TONS

Unit Type MELTING FURNACE Burner Type NORTH AMERICAN

1. Test No.	6-1		6-1		6-1		6-1		6-1	
2. Date										
3. Time	1215		1245		1330		1415			
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	4.4		4.4		5.1		11.0			
9. NOx (hot) read/3% O_2 (ppm)*	75	81	81	88	84	95	—	—		
10. NO (hot) read/3% O_2 (ppm)*	73	79	79	86	82	93	—	—		
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	2	2	2	2	—	—		
12. NO (cold) read/3% O_2 (ppm)*	87	94	97	105	96	109	80	144		
13. Carbon Dioxide (%)	10.7		10.8		10.8		7.8			
14. Carbon Monoxide (ppm) uncor/cor*	5	5	8	9	6	7	5	9		
15. Hydrocarbon (ppm) uncor/cor*	1	1	—		1	1	0	0		
16. Sulfur Dioxide (ppm) uncor/cor*	3	3	3	3	1	1	0	0		
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	95		96		94		95			
19. Dew Point Temp. (°F/°C)	76		76		76		73			
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)	42		41		45		34			
22.					recal					
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 6-2 Date 6-29-76 Location 6 Engr._____

Unit No._____ Fuel N. G. Capacity 43 TONS

Unit Type MELTING FURNACE Burner Type_____

1. Test No.	6-2		6-2		6-2		6-2			
2. Date										
3. Time	1040		1110		1130		1235			
4. Load										
5. Process Rate	75K		→		→		→			
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	5.5		3.57		3.5		2.35			
9. NOx (hot) read/3% O_2 (ppm)*	75	87	88	91	92	95	—	—*		
10. NO (hot) read/3% O_2 (ppm)*	73	85	87	90	90	93	—	—		
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	1	1	2	2	—	—		
12. NO (cold) read/3% O_2 (ppm)*	87	101	104	107	107	110	95	92		
13. Carbon Dioxide (%)	10.8%		11.6		11.4		11.7			
14. Carbon Monoxide (ppm) uncor/cor*	7	8	9	9	10	10	16	15		
15. Hydrocarbon (ppm) uncor/cor*	0	0	1	1	0	0	0	0		
16. Sulfur Dioxide (ppm) uncor/cor*	1	1	2	2	1	1	0	0		
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	85		86		87		91			
19. Dew Point Temp. (°F/°C)	70		71		71		75			
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)	48		48		46		48			
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

* HOT LINE NO COULD NOT BE TAKEN

MOBILE LABORATORY DATA Test No._____

Test No. 6 Date 6-30-76 Location 6 Engr._____

Unit No._____ Fuel #2 OIL Capacity 43 TONS

Unit Type MELTING FURNACE Burner Type NORTH AMERICAN

	*									
1. Test No.	6-3		6-3		6-3		6-3		6-3	
2. Date										
3. Time	1130		1315		1335		1405		1420	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	15.1		7.35		7.1		5.35		4.85	
9. NOx (hot) read/3% O_2 (ppm)*	—		126	166	131	170	148	170	155	173
10. NO (hot) read/3% O_2 (ppm)*	—		125	165	130	168	147	169	154	172
11. NO_2 (hot) read/3% O_2 (ppm)*	—		1	1	1	1	1	1	1	1
12. NO (cold) read/3% O_2 (ppm)*	63	192	138	182	143	185	165	190	173	193
13. Carbon Dioxide (%)	6.45		11.5		11.7		12.4		12.8	
14. Carbon Monoxide (ppm) uncor/cor*	6	18	6	8	6	8	6	7	8	9
15. Hydrocarbon (ppm) uncor/cor*	—		0	0	0	0	0	0	0	0
16. Sulfur Dioxide (ppm) uncor/cor*	—		120	158	122	158	142	163	141	157
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)			89		89		88		89	
19. Dew Point Temp. (°F/°C)			74		73		73		72	
20. Atmos. Pressure (in. Hg)										
21. Relative Humidity (%)			49		47		50		44	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

*HC DATA QUESTIONABLE. INSTRUMENT HAD ZERO DRIFT.

OPERATING DATA

Location 6

Date: 6-28-76 Test: 6

Date Taken By: _____ Test No.: 6-1

Time	12:15	12:45	13:35	14:20	
Gas Flow Rate x 4000 (SCFH)	8.35	8.3	8.35	2.2	
Integrated Gas Flow x 100 (SCH)	669202	669354	669534	669653	
South Side Gas Pressure (in. H_2O)	4.8	4.7	4.7	4.1	
Oil Flow Rate (GPM)					
Integrated Oil Flow (gallons)					
Oil Pressure at Burner (PSIG)					
Furnace Temperature (°F)	N.A.	N.A.	1350	1400	
Flue Gas Temperature (°F)					
Load (lbs)	45000	45000	50K		

1308 ALLOYING ELEMENTS ADDED, FIRE OFF

SCRAP ADDED AT 1310: 5000 #

1321 BURNERS ON AGAIN

OPERATING DATA
Location 6

Date: 6-29-76 Test: 6

Date Taken By: _____ Test No.: 6-2

Time	10:43	11:14	11:30	12:32*	
Gas Flow Rate x 4000 (SCFH)	8.2	8.1	8.15	7.8	
Integrated Gas Flow x 100 (SCH)	672360	672520	672611	672882	
South Side Gas Pressure (in. H_2O)	4.8	4.8	4.8	4.8	
Oil Flow Rate (GPM)					
Integrated Oil Flow (gallons)					
Oil Pressure at Burner (PSIG)					
Furnace Temperature (°F)	N.A.	N.A.	1240	1400	
Flue Gas Temperature (°F)					
Load (lbs)	45607	45607	45607	45607	

* @ 12:30 FURNACE WAS SHUT OFF AUTOMATICLY

DATA WAS TAKEN FROM STRIP CHARTS

OPERATING DATA

Location 6

Date: 6-30-76 Test: 6

Data Taken By: _____ Test No.: 6-3

Time	11:35	13:15	13:29	14:05	14:24
Gas Flow Rate x 4000 (SCFH)					
Integrated Gas Flow x 100 (SCH)					
South Side Gas Pressure (in. H_2O)					
Oil Flow Rate (GPH)	~.7	2.94	2.94	3.33	3.45
Integrated Oil Flow (gallons)	36180	36328	36395	36479	36535
Oil Pressure at Burner (PSIG)	45	45	45	45	45
Furnace Temperature (°F)	1440	N.A.	N.A.	1300	1295
PROBE 13½" IN FLUE GAS Flue Gas Temperature (°F)		1702	1733	1745	1745
Load (lbs)	N.A.	37500	37500	37500	37500

GASEOUS FUEL ANALYSIS

Test No_____

Test No_____ Date_____ Location_____ Engr_____

Unit No._____ Fuel_____ Fuel Sample No_____

Fuel Sample Point_____ Fuel Analysis by_____

Gas		% Volume		CF air / CF fuel	Btu(HHV) / CF fuel	CF CO_2 / CF fuel	CF H_2O / CF fuel	CF Prod / CF fuel	lb Prod / CF fuel
CH_4	Methane	94.52	x	0.0955	9.94	0.01	0.02	0.1055	0.000416
C_2H_6	Ethane	4.26	x	0.1671	17.51	0.02	0.03	0.1821	0.000786
C_3H_8	Propane	0.2	x	0.2387	25.19	0.03	0.04	0.2587	0.001171
C_4H_{10}	Butane	0.025	x	0.3103	33.21	0.04	0.05	0.3353	0.001548
C_5H_{12}	Pentane	0.028	x	0.3819	41.11	0.05	0.06	0.4119	0.001864
C_2H_4	Ethylene		x	0.1432	15.80	0.02	0.02	0.1532	0.000726
C_3H_6	Propylene		x	0.2148	23.33	0.03	0.03	0.2298	0.001087
C_4H_8	Butylene	0.037	x	0.2869	31.23	0.04	0.04	0.3068	0.001449
C_5H_{10}	Pentylene		x	0.3580	39.16	0.05	0.05	0.3830	0.001813
C_2H_2	Acetylene		x	0.1193	14.57	0.02	0.01	0.1343	0.000682
C_6H_6	Benzene	0.032	x	0.3580	38.48	0.06	0.03	0.3730	0.002017
O_2	Oxygen	0.12	x	-0.0477				-0.0377	0.000828
N_2	Nitrogen	0.87						0.01	0.000728
CO_2	Carb. Diox	0.36				0.01		0.01	0.001145
CO	Carb. Monox		x	0.0239	3.15	0.01		0.0289	0.000724
H_2	Hydrogen		x	0.0239	3.18		0.01	0.0289	0.0000522
	Total	100.		9.834	1024	1.046	2.037	10.847	0.0439

Theoretical Air:

$$\frac{\text{SCF air}}{10^6 \text{ Btu}} = \frac{\text{CF air}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = \underline{9.609 \times 10^3} \text{ SCF air}/10^6 \text{ Btu @ 70°F, 29.92 in. Hg.}$$

$$\frac{\text{WSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{CF Prod}}{\text{CF fuel}} \times 10^6 \Big/ \frac{\text{Btu(HHV)}}{\text{CF fuel}} = \underline{1.0596 \times 10^4} \text{ Wet SCF Prod}/10^6 \text{ Btu}$$

$$\% \text{ Moisture} = \frac{\text{CF } H_2O}{\text{CF fuel}} \times 100 \Big/ \frac{\text{CF Prod}}{\text{CF fuel}} = \underline{18.73} \% H_2O$$

$$\frac{\text{DSCF Prod}}{10^6 \text{ Btu}} = \frac{\text{WSCF Prod}}{10^6 \text{ Btu}} \times \frac{(100 - \% \text{ Moisture})}{100} = \underline{8611.4} \text{ Dry SCF}/10^6 \text{ Btu}$$

$$\% CO_2, \text{ dry} = \frac{\text{CF } CO_2}{\text{CF fuel}} \times 100 \Big/ \left(\frac{\text{CF Prod}}{\text{CF fuel}} - \frac{\text{CF } H_2O}{\text{CF fuel}}\right) = \underline{11.87} \% CO_2, \text{ dry}$$

$$K = \frac{331.5 \times 10^6}{\text{MW} \times (\text{DSCF}/10^6 \text{ Btu})}$$

$K' = K/430$

$lb/10^6 \text{ Btu} = (\text{ppm @ 3\% } O_2)/K$

$ng/J = (\text{ppm @ 3\% } O_2)/K'$

	MW	K for lb/10^6 Btu	K' for ng/J
NOx	46	1.195×10^{-3}	.5138
CO	28		
HC	16		
SOx	64		

LOCATION 6

FUEL OIL ANALYSIS

Carbon, %	86.40
Hydrogen, %	13.12
Nitrogen, %	0.040
Sulfur, %	0.25
Ash, %	0.062
Oxygen (by difference), %	0.13
API Gravity at 60°F	34.5
Gross Heat of Combustion, BTU/lb	19,490
Net Heat of Combustion, BTU/lb	18,290

PETROLEUM PROCESS HEATER

Location No. 7 Unit No. 1

Unit Description PETROLEUM PROCESS HEATER
VERTICALLY FIRED NATURAL DRAFT
RECYCLE GAS HEATER

Installation Date 1967

Heater Rating 15.5 MW (52.8×10^6 Btu/hr)

Burner Description JOHN ZINK ASPIRATOR TYPE
16 BURNERS

Test Fuel Combinations REFINERY GAS

Fuel Temp. at Burner (°F) Ambient

Primary Air Temp. (°F) Ambient

Comments:

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/1-1 Date 7-13-76 Location 7 Engr. H. BUENING TECH. R. PIONESSA

Unit No. 1 Fuel REF. GAS Capacity 52.8 MILLION BTU/P/H

Unit Type REFINERY HEATER Burner Type JOHN ZINK ASP. TYPE

1. Test No.	7/1-1		7/1-1		7/1-1		7/1-1		7/1-1	
2. Date	7-13-76		7-13-76		7-13-76		7-13-76		7-13-76	
3. Time	0930		1045		1130		1330		1505	
4. Load	NA		—		—		—		→	
5. Process Rate cu.ft. P/H	8.25×10^3		8.22		8.20		8.01		8.0	
6. Flue Diam. or Size, ft	5'6" OD		—		—		—		→	
7. Probe Position	STACK CENTER		—		—		—		→	
8. Oxygen (%)	7.45		7.98		7.7		7.7		7.85	
9. NOx (hot) read/3% O_2 (ppm)*	67	89	66	91	74	100	60	81	60	82
10. NO (hot) read/3% O_2 (ppm)*	67	89	66	91	72	97	60	81	60	82
11. NO_2 (hot) read/3% O_2 (ppm)*	~~0~~	~~0~~	~~0~~	~~0~~	2	3	~~0~~	~~0~~	~~0~~	~~0~~
12. NO (cold) read/3% O_2 (ppm)*	78	104	79	109	86	116	72	97	73	100
13. Carbon Dioxide (%)	10.2*		7.7		9.0		7.4		8.0	
14. Carbon Monoxide (ppm) uncor/cor*	8	11	8	11	6	8	6	8	8	11
15. Hydrocarbon (ppm) uncor/cor*	25 SEEMS HIGH	33	10	14	8	11	9	12	5	7
16. Sulfur Dioxide (ppm) uncor/cor*	~~0~~	~~0~~	~~0~~	0	48**	54	~~0~~	~~0~~	~~0~~	~~0~~
17. Smoke Spot (Bacharach)	NOT TAKEN		—		—		—		→	
18. Atmos. Temp. (°F/°C)	84.5		86.0		86.0		86.0		89.0	
19. Dew Point Temp. (°F/°C)	78.0		78.0		77.0		78.0		78.0	
20. Atmos. Pressure (in. Hg)	30.085		31.000		30.09		30.08		30.07	
21. Relative Humidity (%)	76.0		71.0		68.0		68.0		62.0	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

* CALIBR. AND READ WITH LINEARIZER. DO NOT USE.

** MIGHT HAVE BEEN ZERO DRIFT.

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/1-1 Date 7-13-76 Location 7 Engr. H. BUENING TECH. R. PIONESSA

Unit No. 1 Fuel REFINERY GAS Capacity 52.8 M BTU P/H

Unit Type REFINERY HEATER Burner Type JOHN ZINK - ASP. TYPE

1. Test No.	7/1-1		7/1-1									
2. Date	7-13-76		7-13-76									
3. Time	1535		1600									
4. Load	NA		—		—		—		—		→	
5. Process Rate	8.00		8.01									
6. Flue Diam. or Size, ft	5'6" O.D.		—		—		—		—		→	
7. Probe Position	STACK CENTER		—		—		—		—		→	
8. Oxygen (%)	7.8		7.8									
9. NOx (hot) read/3% O_2 (ppm)*	58	79	58	79								
10. NO (hot) read/3% O_2 (ppm)*	58	79	57	78								
11. NO_2 (hot) read/3% O_2 (ppm)*	0	0	1	1								
12. NO (cold) read/3% O_2 (ppm)*	74	101	70	96								
13. Carbon Dioxide (%)	7.7		7.5									
14. Carbon Monoxide (ppm) uncor/cor*	7	10	7	10								
15. Hydrocarbon (ppm) uncor/cor*	5	7	5	7								
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	0	0								
17. Smoke Spot (Bacharach)	NOT TAKEN		—		—		—		—		→	
18. Atmos. Temp. (°F/°C)	89.0		87.0									
19. Dew Point Temp. (°F/°C)	80.0		80.0									
20. Atmos. Pressure (in. Hg)	30.06		30.05									
21. Relative Humidity (%)	68.0		74.0									
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/1-2 Date 7-14-76 Location 7 Engr. BUENING/RAY/FIELDS

Unit No. 1 Fuel REF. GAS Capacity 52.8 × 10^6 BTU/HR.

Unit Type REF. HEATER Burner Type JOHN ZINK - ASP. TYPE

1. Test No.	7/1-2		→		→		→		→			
2. Date	7-14		→		→		→		→			
3. Time	0935		1015		1200		1355					
4. Load	—											
5. Process Rate	8.36		8.29		8.33		8.09					
6. Flue Diam. or Size, ft	5'-6" OD		→		→		→		→			
7. Probe Position	CENTER		→		→		→		→			
8. Oxygen (%)	7.3		7.2		6.5		6.8					
9. NOx (hot) read/3% O_2 (ppm)*	61.25	80.5	62	81	63	78	61	77				
10. NO (hot) read/3% O_2 (ppm)*	60	78.8	62.5	82	62	77	61	77				
11. NO_2 (hot) read/3% O_2 (ppm)*	1.25	1.67	Ø	Ø	1	1	Ø	Ø				
12. NO (cold) read/3% O_2 (ppm)*	72.5	95	77	100	77	96	76	96				
13. Carbon Dioxide (%)	8.0		8.3		8.9		8.0					
14. Carbon Monoxide (ppm) uncor/cor*	4	5	6	8	6	7	12	15				
15. Hydrocarbon (ppm) uncor/cor*	10	13	6	8	4	5	9	11				
16. Sulfur Dioxide (ppm) uncor/cor*	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø				
17. Smoke Spot (Bacharach)	—		—		—		—		—			
18. Atmos. Temp. (°F/°C)	80		83		88		85					
19. Dew Point Temp. (°F/°C)	75		76		78		78					
20. Atmos. Pressure (in. Hg)	30.13		30.14		30.15		30.14					
21. Relative Humidity (%)	80		74		65		75					
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

AIR REGISTER ADJUSTMENT

AIR REGISTER ADJUSTMENT

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/1-3 Date 7-15-76 Location 7 Engr. BUENING

Unit No. 1 Fuel REF. GAS Capacity 52.8 x 10^6 BTU/HR

Unit Type REF. HEATER Burner Type JOHN PINK - ASP. TYPE

1. Test No.	7/1-3		→							
2. Date	7-15		7-15		7-15		7-15			
3. Time	0900		0930		1015		1135		1325	
4. Load	—		—		—		—		—	
5. Process Rate 10^3 ft^3/hr	8.22		8.20		8.14		8.06		7.97	
6. Flue Diam. or Size, ft	5'6" O.D.		5'6" O.D.		5'6" O.D.		5'6" OD		5'6" O.D.	
7. Probe Position	CENTER		CENTER		CENTER		CENTER		CENTER	
8. Oxygen (%)	6.9		6.8		6.8		7.1		7.0	
9. NOx (hot) read/3% O_2 (ppm)*	60	77	61	81	61	77	60	78	59	76
10. NO (hot) read/3% O_2 (ppm)*	59	75	63	80	61	77	61	79	59	76
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	1	1	0	0	0	0	0	0
12. NO (cold) read/3% O_2 (ppm)*	74	94	76	96	75	95	78	101	74	95
13. Carbon Dioxide (%)	8.0		8.1		8.0		8.1		8.3	
14. Carbon Monoxide (ppm) uncor/cor*	5	6	6	8	6	8	8	10	2	4
15. Hydrocarbon (ppm) uncor/cor*	9	11	9	11	0	0	<1	<1	6	12
16. Sulfur Dioxide (ppm) uncor/cor*	6	8	6	8	<1	<1	3	4	2	4
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	85		87		85		87		88	
19. Dew Point Temp. (°F/°C)	77		78		78		79		80	
20. Atmos. Pressure (in. Hg)	30.21		30.21		30.22		30.23		30.24	
21. Relative Humidity (%)	71		68		72		70		72	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

BRN. 4-13 005

BRN. 4,9,13 005

4,9,13 005

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/1-3 Date 7-15-76 Location 7 Engr. BUENING

Unit No. 1 Fuel REF. GAS Capacity 52.8 $\times 10^6$ BTU/HR

Unit Type REF. HEATER Burner Type JOHN ZINK - ASP. TYPE

1. Test No.	7/1-3		7/1-3									
2. Date	7-15		7-15									
3. Time	1435		1530									
4. Load	—		—									
5. Process Rate $10^3 ft^3/hr$	8.03		8.05									
6. Flue Diam. or Size, ft	5'6" O.D.		5'6" OD									
7. Probe Position	CENTER		CENTER									
8. Oxygen (%)	7.0		7.2									
9. NOx (hot) read/3% O_2 (ppm)*	62	80	65	85								
10. NO (hot) read/3% O_2 (ppm)*	61	78	62	81								
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	3	4								
12. NO (cold) read/3% O_2 (ppm)*	75	96	80	104								
13. Carbon Dioxide (%)	8.2		8.2									
14. Carbon Monoxide (ppm) uncor/cor*	6	8	3	4								
15. Hydrocarbon (ppm) uncor/cor*	5	6	3	4								
16. Sulfur Dioxide (ppm) uncor/cor*	2	3	1	1								
17. Smoke Spot (Bacharach)	—		—									
18. Atmos. Temp. (°F/°C)	87		88									
19. Dew Point Temp. (°F/°C)	79		80									
20. Atmos. Pressure (in. Hg)	30.24		30.22									
21. Relative Humidity (%)	70		72									
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

230

6,9,12
005

BASELINE

MOBILE LABORATORY DATA Test No. _____

Test No. 7/1-3 Date 7-14-76 Location 7 Engr. BUENING/RAY FIELDS

Unit No. 1 Fuel REF. GAS Capacity 52.8 x 10^6 BTU/hr

Unit Type REF. HEATER Burner Type JOHN PINK - ASP. TYPE

1. Test No.	7/1-3		7/1-3									
2. Date	7-14-76		7-14-76									
3. Time	1530		1600									
4. Load	—		—									
5. Process Rate MCFH	8.20		8.20									
6. Flue Diam. or Size, ft	5'6" O.D.		SAME									
7. Probe Position	CENTER		SAME									
8. Oxygen (%)	7.2		7.15									
9. NOx (hot) read/3% O_2 (ppm)*	62	81	62	81								
10. NO (hot) read/3% O_2 (ppm)*	61	80	62	81								
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	~~0~~	~~0~~								
12. NO (cold) read/3% O_2 (ppm)*	75	98	77	100								
13. Carbon Dioxide (%)	8.0		8.4.									
14. Carbon Monoxide (ppm) uncor/cor*	4	5	4	5								
15. Hydrccarbon (ppm) uncor/cor*	6	8	4	5								
16. Sulfur Dioxide (ppm) uncor/cor*	54	70*	25	32								
17. Smoke Spot (Bacharach)	—		—									
18. Atmos. Temp. (°F/°C)	86		88									
19. Dew Point Temp. (°F/°C)	78		80									
20. Atmos. Pressure (in. Hg)	30.13		30.13									
21. Relative Humidity (%)	70		71									
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

* POSSIBLE FUEL CHANGE

231

2 BOOS 2 BOOS

EXPLANATION OF COMPUTER PRINTOUT OF OPERATING DATA

Location 7

Unit 1

TO13	Product Temperature in S.H. Section, °F
TO14	Product Temperature in S.H. Section, °F
TO15	Product Temperature in S.H. Section, °F
TO16	Product Temperature in S.H. Section, °F
TO17	Product Temperature in S.H. Section, °F
TO18	Product Temperature in S.H. Section, °F
TO19	Product Temperature in S.H. Section, °F
TO20	Product Temperature in S.H. Section, °F
TO21	Stack Gas Temperature, °F
TO22	Convection Section Temperature, °F
TO23	Convection Section Temperature, °F
TO24	Product Temperature to Generator Section, °F
TO26	Product Temperature After Superheater, °F
T246	Superheater Inlet, °F
T250	Generator Outlet, °F
T251	Drum Outlet, °F
T252	Economizer Outlet, °F
A009	% O_2 (Control Room Monitor)
F022	Fuel Gas Flow, MCFH
F029	PRODUCT Feed, MCFH
F104	Feedwater Flow, GPM

HLT
199 0
TEST DATA

THE DATE IS 7-13-1976

TIME 9:29 *Test 7-1-1*

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	802.0000	798.9986	797.5961
T015	790.0000	789.2254	788.5128
T016	798.0000	796.0893	795.2425
T017	783.0000	782.9984	782.7210
T018	780.0000	780.1348	779.2635
T019	771.0000	769.9981	769.3881
T020	782.0000	781.3165	780.4604
T021	608.5000	607.6120	605.9617
T022	1239.0000	1241.4973	1233.6420
T023	1256.0000	1250.6330	1251.0693
T024	641.5000	641.2260	642.8465
T026	790.0999	789.3166	788.5340
T246	768.0000	768.0439	764.3461
T250	447.5000	447.2263	447.5637
T251	446.0000	446.2717	446.2353
T252	450.0000	449.9992	449.8917
A009	13.2000	12.9549	12.9825
F022	56.1000	55.8953	55.2369
F029	8.2500	8.2904	8.1861
F104	108.5000	108.9406	109.0708

6552 STOP

MONITOR
NEXT?

$56.1 \times 10^3 \frac{SCF}{HR} \times 1002 \frac{BTU}{SCF} = 5.62 \times 10^7 \frac{Btu}{HR}$

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-1
Date	7-13-76
Time	9:30
Load	25 $\times 10^3$ ft.^{3}/hr.
Stack Draft	-.29
Convection Section Draft	-.24
Furnace Draft	-.22
Fuel Gas Supply Pressure, psig (gauge pressure)	20.0

HLT
199 0
TEST DATA

THE DATE IS 7-13-1976

TIME 10:44

Test 7/1-1

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	795.0000	799.0720	797.5961
T015	785.0000	789.1459	788.5128
T016	792.0000	796.0721	795.2425
T017	778.0000	782.9980	782.7210
T018	776.0000	780.1462	779.2635
T019	765.0000	769.9605	769.3881
T020	777.0000	781.2570	780.4604
T021	605.5000	607.4794	605.9617
T022	1223.0000	1240.2558	1233.6420
T023	1231.0000	1249.6825	1251.0693
T024	642.5000	641.4244	642.8465
T026	784.5000	789.2130	788.5340
T246	764.5000	767.7388	764.3461
T250	447.5000	447.2395	447.5637
T251	446.0000	446.2952	446.2353
T252	450.0000	449.9990	449.8917
A009	13.4000	13.0233	12.9825
F022	53.7000	55.5294	55.2369
F029	8.2199	8.2729	8.1861
F104	109.2000	109.0478	109.0726

6552 STOP

MONITOR
NEXT?

HLT

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-1
Date	7-13-76
Time	10:45
Load	8.22×10^3 ft.^{3}/hr
Stack Draft	-.3
Convection Section Draft	-.26
Furnace Draft	-.2
Fuel Gas Supply Pressure, psig	19.6

HLT

HLT

199 Ø
TEST DATA

THE DATE IS 7-13-1976

TIME 11:28 Test 7/1-1

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	796.0000	798.4975	797.5961
T015	786.0000	788.5308	788.5128
T016	793.0000	795.4311	795.2425
T017	780.0000	782.3977	782.7210
T018	777.0000	779.5643	779.2635
T019	765.0000	769.4305	769.3881
T020	777.0000	780.7641	780.4604
T021	607.5000	607.3311	605.9617
T022	1233.0000	1238.1625	1233.6420
T023	1245.0000	1247.5290	1251.0693
T024	637.5000	641.3148	642.8465
T026	786.0000	788.5878	788.5340
T246	764.0000	767.2811	764.3461
T250	447.5000	447.1986	447.5637
T251	446.0000	446.2988	446.2353
T252	450.0000	449.9655	449.8917
A009	13.0600	13.0576	12.9825
F022	54.4000	55.2331	55.2369
F029	8.2000	8.2666	8.1861
F104	108.6000	109.0196	109.0708

6552 STOP

MONITOR
NEXT?

HLT

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-1
Date	7-13-76
Time	11:30
Load	8.2×10^3 ft^3/hr
Stack Draft	-.30
Convection Section Draft	-.25
Furnace Draft	-.17
Fuel Gas Supply Pressure, psig	19.4

HLT

HLT
199 0
TEST DATA

THE DATE IS 7-13-1976 Test 7/1-1

TIME 13:29

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	792.0000	797.2601	797.5961
T015	782.0000	787.3652	788.5128
T016	789.0000	794.1285	795.2425
T017	776.0000	781.1286	782.7210
T018	774.0000	778.3391	779.2635
T019	762.0000	768.1546	769.3881
T020	774.0000	779.6020	780.4604
T021	604.5000	606.8393	605.9617
T022	1215.0000	1235.4948	1233.6420
T023	1227.0000	1244.4680	1251.0693
T024	637.0000	640.5369	642.8465
T026	781.8000	787.3181	788.5340
T246	758.5000	766.0891	764.3461
T250	447.5000	447.1036	447.5637
T251	446.0000	446.2354	446.2353
T252	450.0000	449.8932	449.8917
A009	12.9200	13.0586	12.9825
F022	56.4000	55.2445	55.2369
F029	8.0100	8.2331	8.1861
F104	109.3000	109.1153	109.0708

6552 STOP

MONITOR
EXIT?

HLT

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-1
Date	7/13/76
Time	13:29
Load	8.01 $\times 10^3$ ft^3/hr
Stack Draft	-.30
Convection Section Draft	-.23
Furnace Draft	-.33
Fuel Gas Supply Pressure, psig	19.4

HLT
199 0
TEST DATA

Test 7/1-1

THE DATE IS 7-13-1976

TIME 15: 4

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	789.0000	796.4509	797.5961
T015	781.0000	786.6099	788.5128
T016	787.0000	793.2465	795.2425
T017	774.0000	780.2918	782.7210
T018	771.0000	777.4738	779.2635
T019	762.0000	767.1779	769.3881
T020	772.0000	778.7465	780.4604
T021	602.0000	606.3831	605.9617
T022	1215.0000	1233.3347	1233.6420
T023	1236.0000	1243.6298	1251.0693
T024	636.0000	639.7698	642.8465
T026	779.4000	786.3966	788.5340
T246	753.5000	764.8144	764.3461
T250	448.5000	447.1345	447.5637
T251	446.0000	446.2254	446.2353
T252	450.5000	449.9300	449.8917
A009	12.4800	13.0074	12.9825
F022	57.2000	55.4474	55.2369
F029	8.0000	8.2067	8.1861
F104	110.0000	109.1268	109.0708

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-1
Date	7/13/76
Time	15.04
Load	8.0×10^3 Ft^3/hr
Stack Draft	-.30
Convection Section Draft	-.23
Furnace Draft	-.14
Fuel Gas Supply Pressure, psig	19.4

HLT

HLT
199 0
TEST DATA

THE DATE IS 7-13-1976 Test 7/1-1

TIME 15:35

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
I013	.0000	.0000	.0000
I014	789.0000	796.2137	797.5961
I015	781.0000	786.3875	788.5128
I016	787.0000	792.9748	795.2425
I017	775.0000	780.0397	782.7210
I018	771.0000	777.2138	779.2635
I019	764.0000	766.9526	769.3881
I020	772.0000	778.5180	780.4604
I021	600.5000	606.1925	605.9617
I022	1213.0000	1232.6240	1233.6420
I023	1240.0000	1243.1455	1251.0693
I024	635.0000	639.5822	642.8465
I026	780.3000	786.1226	788.5340
I246	753.5000	764.4091	764.3461
I250	447.5000	447.1720	447.5637
I251	446.0000	446.2263	446.2353
I252	450.0000	449.9439	449.8917
A009	12.4800	12.9792	12.9825
F022	55.8000	55.4714	55.2369
F029	8.0000	8.1979	8.1861
F104	109.2000	109.1212	109.0708

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-1
Date	7/13/76
Time	15:35 hrs
Load	8.00×10^3 ft^3/hr
Stack Draft	-.26
Convection Section Draft	-.19
Furnace Draft	-.21
Fuel Gas Supply Pressure, psig	19.4

HLT
199 9
TEST DATA

ILLEGAL MODE

HLT
199 0
TEST DATA

THE DATE IS 7-13-1976 · Test 7/1-1

TIME 16: 0

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	789.0000	795.8710	797.5961
T015	781.0000	786.1419	788.5128
T016	786.0000	792.6629	795.2425
T017	774.0000	779.7878	782.7210
T018	771.0000	776.9337	779.2635
T019	763.0000	766.7458	769.3881
T020	771.0000	778.2253	780.4604
T021	600.5000	605.9342	605.9617
T022	1211.0000	1231.7849	1233.6420
T023	1239.0000	1242.9096	1251.0693
T024	637.0000	639.4553	642.8465
T026	779.6000	785.8380	788.5340
T246	751.0000	763.8814	764.3461
T250	447.5000	447.1855	447.5637
T251	446.0000	446.2271	446.2353
T252	450.0000	449.9460	449.8917
A009	12.3200	12.9538	12.9825
F022	55.7000	55.4476	55.2369
F029	8.0100	8.1901	8.1861
F104	110.1000	109.1057	109.0708

6552 STOP

MONITOR
NEXT? 55.4×10^3 SCF/HR $\times 100$

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	711-1
Date	7/13/76
Time	1600 hrs
Load	8.01 x 10^3 ft^3/hr
Stack Draft	-.28
Convection Section Draft	-.20
Furnace Draft	-.20
Fuel Gas Supply Pressure, psig	19.4

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HLT
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HLT
199 Ø
TEST DATA

THE DATE IS  7-14-1976

   TIME  9:34
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7/1-2(A) Baseline

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
TØ13	.0000	.0000	.0000
TØ14	789.0000	788.2711	791.8353
TØ15	780.0000	778.8165	782.3256
TØ16	788.0000	785.7713	788.7628
TØ17	774.0000	772.7713	776.1278
TØ18	771.0000	769.8165	773.1491
TØ19	761.0000	760.1800	763.3778
TØ20	771.0000	770.3164	774.2950
TØ21	605.5000	602.7030	604.2685
TØ22	1243.0000	1233.6794	1226.6743
TØ23	1249.0000	1247.9514	1240.5473
TØ24	630.5000	632.2031	636.9620
TØ26	779.6000	778.0667	781.6318
T246	769.5000	762.7938	760.4505
T250	446.5000	447.7491	447.6210
T251	446.0000	446.4763	446.4124
T252	449.0000	450.1582	450.0845
AØØ9	14.3500	13.4417	12.5851
FØ22	58.5000	56.5817	54.6901
FØ29	8.3600	8.3627	8.2103
F104	108.7000	108.9043	109.0281

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6552 STOP

MONITOR
NEXT?
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SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-2
Date	7-14-76
Time	9:35
Load	8.36
Stack Draft	-.33
Convection Section Draft	-.25
Furnace Draft	-.15
Fuel Gas Supply Pressure, psig	22.1

HLT
199 0
TEST DATA

(A)
7/1-2 Baseline

THE DATE IS 7-14-1976

TIME 10:21

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	789.0000	788.3181	791.8353
T015	780.2000	778.7580	782.3256
T016	787.0000	785.8784	788.7828
T017	774.0000	772.7983	776.1278
T018	771.0000	769.8780	773.1491
T019	760.0000	760.1578	763.3778
T020	771.0000	770.3579	774.2950
T021	605.5000	602.9981	604.2685
T022	1239.0000	1234.2770	1226.6743
T023	1257.0000	1248.1562	1240.5473
T024	630.5000	631.9584	636.9620
T026	779.6000	778.3022	781.6318
T246	769.0000	763.4581	760.4505
T250	446.5000	447.5589	447.6210
T251	445.0000	446.3389	446.4124
T252	449.0000	449.9790	450.0845
A009	15.0400	13.5871	12.5851
F022	57.0000	56.7878	54.6901
F029	8.2900	8.3575	8.2103
F104	108.4000	108.9917	109.0261

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-2
Date	7-14-76
Time	10:20
Load	8.29
Stack Draft	-.32
Convection Section Draft	-.25
Furnace Draft	-.11
Fuel Gas Supply Pressure, psig	21.1

HLT
199 0
TEST DATA

Test 7/1-2 (B)

THE DATE IS 7-14-1976

TIME 12: 0

Register adjustment

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	795.0000	789.2166	791.8353
T015	774.0000	778.5913	782.3256
T016	786.0000	786.1538	788.7828
T017	771.0000	772.9038	776.1278
T018	769.0000	769.9974	773.1491
T019	757.0000	760.0283	763.3778
T020	768.0000	770.4346	774.2950
T021	596.5000 X	603.1383	604.2685
T022	1252.0000	1236.6833	1226.6743
T023	1277.0000	1250.6203	1240.5473
T024	631.0000	631.7320	636.9620
T026	778.0999	778.5664	781.6318
T246	753.5000	763.4349	760.4505
T250	446.5000	447.4205	447.6210
T251	446.0000	446.2018	446.4124
T252	450.0000	449.8424	450.0845
A009	11.1700 +	13.3187	12.5851
F022	56.1000 +	56.6686	54.6901
F029	8.3299 +	8.3471	8.2103
F104	108.6000	108.9965	109.0281

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	711-2
Date	7-14-76
Time	12:00
Load	8.33
Stack Draft	-.38
Convection Section Draft	-.3
Furnace Draft	-.26
Fuel Gas Supply Pressure, psig	20.6

HLT
199 0
TEST DATA

THE DATE IS 7-14-1976

TIME 13:54

Test 7/1-2 (B)
Register adjustm.

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	797.0000	790.7222	791.8353
T015	777.0000	778.1219	782.3256
T016	787.0000	786.2467	788.7828
T017	774.0000	772.8466	776.1278
T018	771.0000	770.0717	773.1491
T019	761.0000	760.1463	763.3778
T020	770.0000	770.3215	774.2950
T021	590.0000*	601.0467	604.2685
T022	1233.0000	1237.3942	1226.6743
T023	1270.0000	1254.7692	1240.5473
T024	635.0000	631.8846	636.9820
T026	779.4000	778.7744	781.6318
T246	736.0000	759.4093	760.4505
T250	448.5000	447.4358	447.8210
T251	446.5000	446.1232	446.4124
T252	450.0000	449.8109	450.0845
A009	11.9200*	12.9971	12.5851
F022	52.7000*	56.2048	54.6901
F029	8.0900*	8.3157	8.2103
F104	109.2000*	109.0795	109.0281

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-2
Date	7/14/76
Time	14:00
Load	8.09
Stack Draft	-.28
Convection Section Draft	-.25
Furnace Draft	-.22
Fuel Gas Supply Pressure, psig	19.5

199 Ø
TEST DATA

THE DATE IS 7-15-1976

TIME 9: 1

Test 7/1-3
Baseline (new regist. position)

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	798.0000	793.3485	793.5651
T015	780.0000	780.9486	779.6697
T016	788.0000	790.0981	786.3564
T017	776.0000	776.7984	774.7321
T018	771.0000	772.3983	768.8153
T019	765.0000	765.0986	762.6271
T020	773.0000	773.6987	769.1378
T021	594.5000	595.1734	594.5551
T022	1262.0000	1273.0971	1245.8188
T023	1275.0000	1281.4472	1276.6730
T024	636.0000	633.7985	632.9985
T026	781.3000	782.4736	779.5517
T246	748.5000	749.4986	749.1748
T250	448.5000	448.5991	448.0274
T251	446.5000	447.5991	446.3710
T252	450.5000	450.8742	450.0843
A009	11.5300	11.3864	12.1866
F022	56.8000	56.5949	55.3869
F029	8.2199	8.2719	8.2570
F104	108.6000	109.0548	109.1427

6552 STOP

MONITOR
NEXT?

$56.4 \times 10^3 \frac{SCF}{HR} \times 978.6 \frac{BTU}{SCF} = 55.6 \times 10^6 \frac{BTU}{HR}$

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3 BASELINE
Date	7-15-76
Time	9:01
Load	8.22
Stack Draft	-.32
Convection Section Draft	-.28
Furnace Draft	-.24
Fuel Gas Supply Pressure, psig	20.4

HLT

Test 7/1 - (3) 4
Baseline

HLT
199 0
TEST DATA

THE DATE IS 7-15-1976

TIME 9:30

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	799.0000	799.3619	793.5651
T015	782.0000	780.9984	779.6697
T016	789.0000	790.0435	786.3564
T017	777.0000	776.8619	774.7321
T018	773.0000	772.4526	768.8153
T019	765.0000	765.1802	762.6271
T020	774.0000	773.7258	769.1378
T021	594.0000	595.0891	594.5551
T022	1262.0000	1272.3603	1245.8188
T023	1277.0000	1281.1789	1276.6730
T024	636.0000	633.9530	632.9985
T026	782.6000	782.5166	779.5517
T246	745.5000	749.1120	749.1748
T250	449.0000	448.5898	448.0274
T251	447.5000	447.5899	446.3710
T252	450.5000	450.8173	450.0843
A009	10.9200	11.3599	12.1866
F022	55.1000	56.3817	55.3869
F029	8.2000	8.2654	8.2570
F104	108.7000	109.0679	109.1427

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3
Date	7/15/76
Time	9:30
Load	8.2
Stack Draft	-.32
Convection Section Draft	-.26
Furnace Draft	-.22
Fuel Gas Supply Pressure, psig	20.1

HLT
199 0
TEST DATA

4A

THE DATE IS 7-15-1976

TIME 10:14

test 7/1-③ & B005

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	804.0000	799.5180	793.5651
T015	785.0000	781.2380	779.6697
T016	790.0000	789.9578	786.3564
T017	778.0000	776.8780	774.7321
T018	767.0000	772.1177	768.8153
T019	768.0000	765.3181	762.6271
T020	765.0000	773.2382	769.1378
T021	593.0000	594.8581	594.5551
T022	1241.0000	1269.2363	1245.8188
T023	1207.0000	1276.0766	1276.6730
T024	635.0000	634.1580	632.9985
T026	783.3000	782.5062	779.5517
T246	743.0000	748.4581	749.1748
T250	448.5000	448.6188	448.0274
T251	446.5000	447.4989	446.3710
T252	450.5000	450.7789	450.0843
A009	10.8100	11.3207	12.1866
F022	55.5000	56.3358	55.3869
F029	8.1400	8.2503	8.2570
F104	109.0000	109.0997	109.1427

6552 STOP

MONITOR
NEXT?

$55.5 \times 10^3 \times 978.6$

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3 B005
Date	7/15/76
Time	10:15
Load	8-14
Stack Draft	-.32
Convection Section Draft	-.25
Furnace Draft	-.2
Fuel Gas Supply Pressure, psig	25.1

HLT
199 0
TEST DATA

4B

Test 7/1-(3)
3 BOOS

THE DATE IS 7-15-1976

TIME 11:35

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	795.0000	800.1311	793.5651
T015	784.0000	781.7976	779.6697
T016	794.0000	790.3640	786.3564
T017	775.0000	776.8977	774.7321
T018	772.0000	771.6641	768.8153
T019	759.0000	765.2642	762.8271
T020	773.0000	772.3311	769.1378
T021	592.5000	594.4975	594.5551
T022	1277.0000	1267.2282	1245.8188
T023	1219.0000	1265.2958	1276.6730
T024	635.0000	634.3643	632.9985
T026	782.4000	782.6511	779.5517
T246	744.5000	747.6976	749.1748
T250	448.5000	448.6152	448.0274
T251	446.5000	447.3486	446.3710
T252	451.5000	450.7486	450.0843
A009	11.0620	11.2519	12.1866
F022	55.1000	56.0631	55.3869
F029	8.0600	8.2283	8.2570
F104	109.5000	109.0697	109.1427

6552 STOP

MONITOR
NEXT?

$53.55 \times 10^3 \times 578.6$

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3
Date	7/15/76
Time	11:35
Load	8.06
Stack Draft	-.32
Convection Section Draft	-.28
Furnace Draft	-.16
Fuel Gas Supply Pressure, psig	27.9

HLT
199 ø
TEST DATA

Test 7/1-(3) JB
3 1300s

THE DATE IS 7-15-1976

TIME 13:23

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
Tø13	.ØØØØ	.ØØØØ	.ØØØØ
Tø14	8ø1.ØØØØ	8ØØ.2Ø76	793.5651
Tø15	787.ØØØØ	782.6547	779.6697
Tø16	795.ØØØØ	791.2597	786.3564
Tø17	777.ØØØØ	776.8127	774.7321
Tø18	774.ØØØØ	772.Ø494	768.8153
Tø19	76ø1.ØØØØ	764.2Ø76	762.ØØ71
Tø2Ø	774.ØØØØ	772.5766	769.1378
Tø21	588.ØØØØ	593.ØØ85	594.5551
Tø22	1281.ØØØØ	1269.8Ø98	1245.8188
Tø23	1216.ØØØØ	1254.7839	1276.6736
Tø24	637.ØØØØ	634.8654	632.9985
Tø26	785.ØØØØ	782.9136	779.5517
T246	736.5ØØØ	746.5101	749.1748
T25Ø	448.5ØØØ	446.ØØ299	446.ØØ274
T251	447.5ØØØ	447.2484	446.3710
T252	45Ø.5ØØØ	45Ø.6564	45Ø.Ø843
AØØ9	1Ø.64ØØ	11.1373	12.1866
FØ22	52.ØØØØ	55.5556	55.3869
FØ29	7.97ØØ X	8.1876	8.2570
F1Ø4	1Ø9.5ØØØ	1Ø9.1Ø22	1Ø9.1427

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3
Date	7/15/76
Time	11:25
Load	2.97
Stack Draft	-.31
Convection Section Draft	-.28
Furnace Draft	-.14
Fuel Gas Supply Pressure, psig	27.0

HLT
199 0
TEST DATA

7/1-3

THE DATE IS 7-15-1976

3 BOOS

TIME 14:32

6-9-13

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	802.0000	800.3300	793.5651
T015	777.0000	782.5440	779.6697
T016	797.0000	791.7104	786.3564
T017	769.0000	776.3775	774.7321
T018	778.0000	772.4249	768.8153
T019	754.0000	763.4967	782.6271
T020	783.0000	773.1633	769.1378
T021	588.0000	593.1035	594.5551
T022	1327.0000	1273.1838	1245.6188
T023	1232.0000	1251.8986	1276.6730
T024	638.5000	635.0799	632.9985
T026	782.6000	782.9515	779.5517
T246	747.0000	746.2227	749.1748
T250	448.5000	448.6292	448.0274
T251	446.5000	447.1867	446.3710
T252	450.0000	450.6173	450.0843
A009	10.9799	11.1261	12.1866
F022	52.7000	55.4116	55.3869
F025	8.0300	8.1694	8.2570
F104	108.4000	109.0876	109.1427

6552 STOP

MONITOR
NEXT?

$52.7 \times 10^3 \times 978.6 = 51.6 \times 10^6$ BTU/HR

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3 B005 6-9-13
Date	7/15/76
Time	14:35
Load	8.03
Stack Draft	-.35
Convection Section Draft	-.28
Furnace Draft	-.19
Fuel Gas Supply Pressure, psig	26.3

HLT
199 0
TEST DATA

Test 7/1-3
Baseline

THE DATE IS 7-15-1976

TIME 15:31

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	796.0000	800.3878	793.5651
T015	785.0000	782.3439	779.6697
T016	790.0000	791.8870	786.3564
T017	782.0000	776.2572	774.7321
T018	774.0000	772.7352	768.8153
T019	768.0000	763.2790	782.6271
T020	774.0000	773.6051	769.1378
T021	588.0000	592.6700	594.5551
T022	1254.0000	1274.3840	1245.8188
T023	1268.0000	1252.0585	1276.6730
T024	636.0000	635.2027	632.9985
T026	784.8000	783.0421	779.5517
T246	736.0000	745.6809	749.1748
T250	448.5000	448.5959	448.0274
T251	447.5000	447.1176	446.3710
T252	450.5000	450.5960	450.0843
A009	10.6800	11.1053	12.1866
F022	51.9000	55.1975	55.3869
F029	8.0500	8.1564	8.2570
F104	108.7000	109.0691	109.1427

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3 BASELINE
Date	7/15/76
Time	1535
Load	8.05
Stack Draft	-.32
Convection Section Draft	-.30
Furnace Draft	-.31
Fuel Gas Supply Pressure, psig	18.9

HLT
199 Ø
TEST DATA

Test 7/1-3

THE DATE IS 7-14-1976

TIME 15:58

Boos

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
TØ13	.0000	.0000	.0000
TØ14	792.0000	791.3924	791.8353
TØ15	782.0000	778.4548	782.3256
TØ16	783.0000	786.1624	788.7628
TØ17	777.0000	773.3503	776.1278
TØ18	761.0000	769.3503	773.1491
TØ19	763.0000	760.6414	763.3778
TØ20	761.0000	769.4959	774.2950
TØ21	589.0000	599.1104	604.2685
TØ22	1230.0000	1236.3471	1226.6743
TØ23	1312.0000	1261.8056	1240.5473
TØ24	634.5000	632.2674	636.9820
TØ26	777.3000	778.7817	781.6318
T246	740.5000	756.2877	760.4505
T250	445.0000	447.6126	447.8210
T251	447.5000	446.1856	446.4124
T252	450.5000	449.9043	450.0845
AØØ9	11.8900	12.8168	12.5851
FØ22	52.2000	55.5914	54.6901
FØ29	8.2000	8.2874	8.2103
FIØ4	109.7000	109.0536	109.0281

6552 STOP

MONITOR
NEXT?

Load $52.2 \times 10^3 \times 104.4 = 5.44 \times 10^7$

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3
Date	7/14/76
Time	16:00
Load	8.2
Stack Draft	-.32
Convection Section Draft	-.3
Furnace Draft	-.25
Fuel Gas Supply Pressure, psig	23.8

HLT
199 0
TEST DATA

THE DATE IS 7-14-1976

Test 7/1-3

TIME 15:31

Boos

LOOP	CURRENT READING	SINCE 4 AM	YESTERDAYS AVERAGE
T013	.0000	.0000	.0000
T014	795.0000	791.2576	791.8353
T015	782.0000	778.2575	782.3256
T016	785.0000	786.1917	788.7828
T017	777.0000	773.1701	776.1278
T018	782.0000	769.6484	773.1491
T019	764.0000	760.4741	763.3778
T020	782.0000	769.7786	774.2950
T021	589.0000	599.4960	604.2685
T022	1224.0000	1236.5585	1226.6743
T023	1317.0000	1259.2980	1240.5473
T024	633.5000	632.2142	636.9820
T026	778.3000	778.7878	781.6318
T246	743.0000	756.8332	760.4505
T250	448.5000	447.5742	447.8210
T251	446.5000	446.1503	446.4124
T252	450.5000	449.8786	450.0845
A009	11.9500	12.8716	12.5851
F022	53.8000	55.7649	54.6901
F029	8.2000	8.2905	8.2103
F104	109.1000	109.0647	109.0281

6552 STOP

MONITOR
NEXT?

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 1

Test	7/1-3
Date	7-14-76
Time	15:35
Load	8.2
Stack Draft	-.3
Convection Section Draft	-.26
Furnace Draft	-.24
Fuel Gas Supply Pressure, psig	24.1

LOCATION 7

Fuel Gas Analysis

Unit 1

METHOD: Mass Spectrometry

Component	Refinery Gas Test 7/1-3
methane	60.95 mole %
ethane	3.94
propane	4.90
i-butane	.63
n-butane	1.01
pentane	.51
hexane	.34
C_6^+	.07
ethene	.89
propene	1.14
butene	.67
cyclohexane	.02
benzene	.01
nitrogen	2.34
oxygen	.63
carbon dioxide	.06
water	.08
hydrogen	21.81

LOCATION 7

O_2 Traverse

Date 7-12-76 Unit 1 Sample Point

Probe Position ~~(inches from back wall)~~ DEPTH	O_2 (%)	Calif	CO (ppm)
5'-5"	8.35	83.7	
4'-11"	8.25		
4'-5"	8.25		
3'-11"	8.1		
3'-5"	8.1		
2'-11"	8.0		
2'-5"	8.1		
1'-11"	8.0		
1'-5"	8.0		
11"	7.9		
5"	7.9	80.5	
Average			

PETROLEUM PROCESS HEATER

Location No. 7 Unit No. 2

Unit Description PETROLEUM PROCESS HEATER
VERTICALLY FIRED NATURAL DRAFT HEATER

Installation Date 1970

Heater Rating 11 MW (37.6x10^6 Btu/hr)

Burner Description JOHN ZINK
12 BURNERS ON CENTER LINE

Test Fuel Combinations REFINERY GAS

Fuel Temp. at Burner (°F) Ambient

Primary Air Temp. (°F) Ambient

Comments:

MOBILE LABORATORY DATA Test No. _____

Test No. 7/2-1 Date 7-19-76 Location 7 Engr. BUENING

Unit No. 2 Fuel REF. GAS Capacity 37.6 x 10^6 BTU/Hr.

Unit Type REF. HEATER Burner Type JOHN ZINK

1. Test No.	7/2-1		→		→		→		→	
2. Date	7-19-76		7-19-76		7-19-76		7-19-76		7-19-76	
3. Time	1400		1455		1530		1600		1630	
4. Load	—		—		—		—		—	
5. Process Rate 10^3/BD	41.31		41.87		41.97		41.56		41.00	
6. Flue Diam. or Size, ft										
7. Probe Position	37" IN		37" IN		37" IN		37" IN	→		
8. Oxygen (%)	8.6		8.4		8.6		8.7		8.4	
9. NOx (hot) read/3% O_2 (ppm)*	60	87	55	79	53	77	55	80	55	79
10. NO (hot) read/3% O_2 (ppm)*	55	80	54	77	52	75	51	75	52	74
11. NO_2 (hot) read/3% O_2 (ppm)*	5	7	1	1	1	1	4	6	3	4
12. NO (cold) read/3% O_2 (ppm)*	67	97	64	91	62	90	64	94	64	91
13. Carbon Dioxide (%)	6.5		7.0		6.9		7.2		7.4	
14. Carbon Monoxide (ppm) uncor/cor*	10	15	8	11	8	12	6	9	8	11
15. Hydrocarbon (ppm) uncor/cor*	1	1	0	0	2	3	4	6	6	9
16. Sulfur Dioxide (ppm) uncor/cor*	3	4	4	6	4	6	5	7	2	3
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	94		94		93		93		94	
19. Dew Point Temp. (°F/°C)	76		83		81		77		78	
20. Atmos. Pressure (in. Hg)	30.30		30.27		30.27		30.28		30.30	
21. Relative Humidity (%)	44		64		61		49		50	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/2-2 Date 7-20-76 Location 7 Engr. BUENING

Unit No. 2 Fuel REF. GAS Capacity 37.6 x 10^6 BTU/HR

Unit Type REF. HEATER Burner Type JOHN ZINK

1. Test No.	7/2-2		—		—		—		—		→
2. Date	7-20		—		—		—		—		→
3. Time	0900		0935		1025		1100		13:20		
4. Load	—		—		—		—		—		
5. Process Rate	41.09		41.41		41.7		41.88		41.16		
6. Flue Diam. or Size, ft											
7. Probe Position	~37" in		—		—		—		—		→
8. Oxygen (%)	8.3		8.6		8.6		9.3		8.7		
9. NOx (hot) read/3% O_2 (ppm)*	54	77	55	80	42	61	45	69	41	60	
10. NO (hot) read/3% O_2 (ppm)*	50	71	52	75	42	61	42	65	41	60	
11. NO_2 (hot) read/3% O_2 (ppm)*	4	6	3	4	0	0	3	5	0	0	
12. NO (cold) read/3% O_2 (ppm)*	60	85	62	90	50	73	51	78	47	69	
13. Carbon Dioxide (%)	7.1		7.6		6.9		7.1		7.7		
14. Carbon Monoxide (ppm) uncor/cor*	4	6	8	12	5	7	4	6	12	18	
15. Hydrocarbon (ppm) uncor/cor*	9	13	5	7	5	7	5	8	4	6	
16. Sulfur Dioxide (ppm) uncor/cor*	2	3	1	1	1	1	1	1	1	1	
17. Smoke Spot (Bacharach)	—		—		—		—		—		
18. Atmos. Temp. (°F/°C)	88		87		90		97		97		
19. Dew Point Temp. (°F/°C)	78		77		78		80		81		
20. Atmos. Pressure (in. Hg)	30.34		30.34		30.32		30.34		30.33		
21. Relative Humidity (%)	65		64		59		48		50		
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

BASELINE

BASELINE

REG. ADJUSTM.

REG. ADJUSTM.

REG. ADJUSTM.

MOBILE LABORATORY DATA Test No. _____

Test No. 7/2-2 Date 7-20-76 Location 7 Engr. HANS

Unit No. 2 Fuel REF. GAS Capacity 37.6 $\times 10^6$ BTU/hr

Unit Type REF. HEATER Burner Type JOHN ZINK

1. Test No.	7/2-2		7/2-2									
2. Date	7-20		7-20									
3. Time	1355		1500									
4. Load	—		—									
5. Process Rate	41.28		41.38									
6. Flue Diam. or Size, ft												
7. Probe Position	~37" in		~37" in									
8. Oxygen (%)	8.5		8.3									
9. NOx (hot) read/3% O_2 (ppm)*	42	60	55	78								
10. NO (hot) read/3% O_2 (ppm)*	40	58	55	78								
11. NO_2 (hot) read/3% O_2 (ppm)*	2	3	0	0								
12. NO (cold) read/3% O_2 (ppm)*	50	72	65	92								
13. Carbon Dioxide (%)	8.0		6.7									
14. Carbon Monoxide (ppm) uncor/cor*	8	12	8	11								
15. Hydrocarbon (ppm) uncor/cor*	4	6	2	3								
16. Sulfur Dioxide (ppm) uncor/cor*	2	3	2	3								
17. Smoke Spot (Bacharach)	—		—									
18. Atmos. Temp. (°F/°C)	97		96									
19. Dew Point Temp. (°F/°C)	81		80									
20. Atmos. Pressure (in. Hg)	30.34		30.31									
21. Relative Humidity (%)	50		50									
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

278

REGISTER ADJUSTM.

BASELINE

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/2-3 Date 7-21-76 Location 7 Engr. BUENING

Unit No. 2 Fuel REF. GAS Capacity 37.6 × 10^6 BTU/HR.

Unit Type REF. HEATER Burner Type JOHN ZINK

1. Test No.	7/2-3		7/2-3		7/2-3		7/2-3		7/2-3	
2. Date	7-21-76									
3. Time	0915		1000		1105		1300		1330	
4. Load	—		—		—		—		—	
5. Process Rate	42.75		42.62		42.97		42.81		43.00	
6. Flue Diam. or Size, ft										
7. Probe Position	~37" in		~37" in		~37" in		~37" in		~37" in	
8. Oxygen (%)	7.85		7.8		7.9		8.7		8.5	
9. NOx (hot) read/3% O_2 (ppm)*	54	74	51	70	50	69	44	64	44	63
10. NO (hot) read/3% O_2 (ppm)*	51	70	49	67	47	65	45	66	41	59
11. NO_2 (hot) read/3% O_2 (ppm)*	3	4	2	3	3	4	0	0	3	4
12. NO (cold) read/3% O_2 (ppm)*	62	85	58	79	56	77	55	80	50	72
13. Carbon Dioxide (%)	8.0		7.7		7.4		7.1		7.4	
14. Carbon Monoxide (ppm) uncor/cor*	4	5	6	8	6	8	8	12	8	12
15. Hydrocarbon (ppm) uncor/cor*	9	12	4	5	4	5	2	3	3	4
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	0	0	0	0	0	0	0	0
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	82		84		85		94		93	
19. Dew Point Temp. (°F/°C)	74		76		76		79		78	
20. Atmos. Pressure (in. Hg)	30.32		30.30		30.29		30.29		30.29	
21. Relative Humidity (%)	69		70		67		52		52	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

279

BASELINE

BASELINE

REGISTER ADJUSTM.

BOOS #5+7

BOOS #5+7

MOBILE LABORATORY DATA Test No. _____

Test No. 7/2-3 Date 7-21-76 Location 7 Engr. HANS

Unit No. 2 Fuel REF. GAS Capacity 37.6 × 10^6 BTU/hr

Unit Type REF. HEATER Burner Type JOHN ZINK

1. Test No.	7/2-3		7/2-3		7/2-3							
2. Date	7-21-76		7-21-76		7-21-76							
3. Time	1430		1500		1545							
4. Load	—		—		—							
5. Process Rate	43.09		43.12		43.59							
6. Flue Diam. or Size, ft												
7. Probe Position	~37" in		~37" in		~37" in							
8. Oxygen (%)	8.5		8.6		8.0							
9. NOx (hot) read/3% O_2 (ppm)*	42	60	42	61	47	65						
10. NO (hot) read/3% O_2 (ppm)*	40	58	40	58	46	61						
11. NO_2 (hot) read/3% O_2 (ppm)*	2	3	2	3	1	1						
12. NO (cold) read/3% O_2 (ppm)*	51	73	52	75	55	76						
13. Carbon Dioxide (%)	8.0		7.1		8.0							
14. Carbon Monoxide (ppm) uncor/cor*	6	9	9	13	8	11						
15. Hydrocarbon (ppm) uncor/cor*	0	0	2	3	5	7						
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	0	0	0	0						
17. Smoke Spot (Bacharach)	—		—		—							
18. Atmos. Temp. (°F/°C)	88		89		91							
19. Dew Point Temp. (°F/°C)	77		77		78							
20. Atmos. Pressure (in. Hg)	30.28		30.26		30.25							
21. Relative Humidity (%)	62		59		56							
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

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Data Sheet 6002-2

BOOS 2+11

BOOS 2+11 BASELINE TEST

EXPLANATION OF COMPUTER PRINTOUT OF OPERATING DATA

Location 7

Unit 2

T401	Product Outlet Temperature	
T423	Product Inlet Temperature, left side	
T424	Product Inlet Temperature, right side	
F403	Product Feed (Naphta)	Total Product Feed
F441	Recy. Gas Flow	
F442	Recy. Gas Flow	
T601	Temperature in Convec. Section	
T603	Stack Temperature	
F440	Fuel Gas Flow	

HALT!
240 0
LOOP DISPLAY

O2 Traverse 7-19-76
11:30 AM

ENTER LOOP NO. (LETTER & 3 DIGITS)

```
TYPE A  T401 =  580.625 DEGF
TYPE A  T423 =  480.000 DEGF
TYPE A  T424 =  469.500 DEGF
TYPE A  F403 =   41.375 MBPD
TYPE A  F441 =  364.500 MCFH
TYPE A  F442 =  364.875 MCFH
TYPE A  T601 = 1084.000 DEGF
TYPE A  T602 =     .000 DEGF
TYPE A  T603 =  945.000 DEGF
TYPE A  T507
ERR E   77  240 6272 STOP
```

MONITOR
NEXT?
T510??
NEXT?

HALT!
240 0
LOOP DISPLAY

ENTER LOOP NO. (LETTER & 3 DIGITS)

```
TYPE A  T511
ERR E   77  240 6272 STOP
```

MONITOR
NEXT?

UNIT 2

7-19-76 Test 7/2-1

14:00 Baseline

T 401	580 °F
T 423	479 °F
T 424	469 °F
F 403	41.31 MBPD
F 441	361.0 MCFH
F 442	363.7 MCFH
T 601	1078 °F
T 603	946 °F

UNIT 2

7-19-76 TEST 7/2-1

14:50 BASELINE

T 401	579 °F
T 423	478 °F
T 424	469 °F
F 403	41.87 MBPD
F 441	364.5 MCFH
F 442	361.8 MCFH
T 601	1074 °F
T 603	944 °F

```
SUPERVISOR INITIALIZATION                                    Baseline

ERR R  306  148  228
HALT!                                          7-19-76
240 0
LOOP DISPLAY                                   Test 7/2-1
                                               Time 15:30
ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A  T401 =  580.000 DEGF
TYPE A  T423 =  479.250 DEGF
TYPE A  T424 =  469.500 DEGF
TYPE A  F403 =   41.968 MBPD
TYPE A  F441 =  364.500 MCFH
TYPE A  F442 =  364.125 MCFH
TYPE A  T601 = 1076.000 DEGF
TYPE A  T603 =  947.000 DEGF
TYPE A
HALT!
```

```
                                               TEST  7/2-1

HALT!
240 0                                          7-19-76  BASELINE
LOOP DISPLAY
                                               1600 HRS
ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A  T401 =  580.000 DEGF
TYPE A  T423 =  479.250 DEGF
TYPE A  T424 =  470.250 DEGF
TYPE A  F403 =   41.562 MBPD
TYPE A  F441 =  365.625 MCFH
TYPE A  F442 =  361.500 MCFH
TYPE A  T601 = 1069.000 DEGF
TYPE A  T603 =  946.000 DEGF
TYPE A
```

Test 7/2-1 Baseline

7-19-76

Time 16:30

```
HALT!
240 0
LOOP DISPLAY

ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A  T401 =  578.750 DEGF
TYPE A  T423 =  479.250 DEGF
TYPE A  T424 =  468.750 DEGF

TYPE A  F441 =  363.750 MCFH
TYPE A  F442 =  362.250 MCFH
TYPE A  T601 = 1066.000 DEGF
TYPE A  T603 =  943.000 DEGF
TYPE A
HALT!
```

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 2

Test No.	7/2-1	7/2-1	7/2-1	7/2-1	7/2-1	7/2-1		
Date	7-19	7-19	7-19	7-19	7-19	7-19		
Time	11:30	14:00	14:50	15:30	1600	16:30		
Load [MBPD]	41.38	41.31	41.78	41.97	41.56			
Firebox east	~-1.0	>1.0	-.83	>1.0	-.90	-.85		
Firebox west	~-1.0	>1.0	-.90	-.88	-.86	-.85		
Stack Pressure	-.79	-.73	-.73	-.75	-.80	-.72		
Plenum PT. 1	-.53	-.54	-.51	-.53	-.52	-.51		
Plenum PT. 2	-.53	-.53	-.53	-.53	-.56	-.52		
Plenum PT. 3	-.51	-.52	-.52	-.5	-.52	-.51		
C.R. Stack O_2 (%)	13.2	13.0	13.7	—	12.5	13.0		
Pressure in Gas Manifold	18.1	19.4	18.9	18.9	19.0	18.7		

"H_2O

O_2 TRAVERSE

BASELINE

BASELINE

```
HALT!
240 0
LOOP DISPLAY

ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A   T401 =  580.625 DEGF
TYPE A   T423 =  481.500 DEGF
TYPE A   T424 =  469.500 DEGF
TYPE A   F403 =   41.093 MBPD
TYPE A   F441 =  360.750 MCFH
TYPE A   F442 =  357.000 MCFH
TYPE A   T601 = 1080.000 DEGF
TYPE A   T603 =  946.000 DEGF
TYPE A
HALT!
```

Test 7/2-2 Baseline

Time 9:00

7/20/76

Test 7/2-2 Baseline

7/20/76 9:35

```
HALT!
240 0
LOOP DISPLAY

ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A   T401 =  581.250 DEGF
TYPE A   T423 =  481.500 DEGF
TYPE A   T424 =  470.250 DEGF
TYPE A   F403 =   41.406 MBPD
TYPE A   F441 =  360.000 MCFH
TYPE A   F442 =  361.500 MCFH
TYPE A   T601 = 1114.000 DEGF
TYPE A   T603 =  943.000 DEGF
TYPE A
```

Test 7/2-2 Reg. adj.

HALT!
240 0
LOOP DISPLAY

JUL 20 1976

Time 10:25

ENTER LOOP NO. (LETTER & 3 DIGITS)

7-20-76

```
TYPE A   F440 =   52.018 MCFH
TYPE A   T401 =  580.625 DEGF
TYPE A   T423 =  480.000 DEGF
TYPE A   T424 =  468.000 DEGF
TYPE A   F403 =   41.718 MBPD
TYPE A   F441 =  363.000 MCFH
TYPE A   F442 =  364.125 MCFH
TYPE A   T601 = 1065.000 DEGF
TYPE A   T603 =  917.000 DEGF
TYPE A
HALT!
```

$520 \times 10^3 \times 975.9 = 5.1 \times 10^8$

JUL 20 1976

Reg. adjustm.
Test 7/2-2
11:00

```
HALT!
240 0
LOOP DISPLAY

ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A   F440 =   52.106 MCFH
TYPE A   T401 =  579.375 DEGF
TYPE A   T423 =  480.000 DEGF
TYPE A   T424 =  468.750 DEGF
TYPE A   F403 =   41.875 MBPD
TYPE A   F441 =  360.000 MCFH
TYPE A   F442 =  365.625 MCFH
TYPE A   T601 = 1036.000 DEGF
TYPE A   T603 =  917.000 DEGF
TYPE A
HALT!
```

JUL 20 1976

Test 7/2-2 (C)

240 0
LOOP DISPLAY

Time 13:20

ENTER LOOP NO. (LETTER & 3 DIGITS)

Reg. adjustm.

```
TYPE A   F440 =   51.449 MCFH
TYPE A   T401 =  579.375 DEGF
TYPE A   T423 =  480.750 DEGF
TYPE A   T424 =  468.750 DEGF
TYPE A   F403 =   41.156 MBPD
TYPE A   F441 =  364.875 MCFH
TYPE A   F442 =  364.875 MCFH
TYPE A   T601 = 1041.000 DEGF
TYPE A   T603 =  913.000 DEGF
TYPE A
HALT!
```

51.4 X 10³ x 1026 =

JUL 20 1976 Time 1400

HALT!
240 0
LOOP DISPLAY Reg. adjustm.

ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A F440 = 50.531 MCFH
TYPE A T401 = 580.000 DEGF
TYPE A T423 = 481.500 DEGF
TYPE A T424 = 468.750 DEGF
TYPE A F403 = 41.281 MBPD
TYPE A F441 = 363.000 MCFH
TYPE A F442 = 365.625 MCFH
TYPE A T601 = 1042.000 DEGF
TYPE A T603 = 913.000 DEGF
TYPE A

$50.5 \times 10^3 \times 1026 = 51.8 \times 10^6$

JUL 20 1976

Test 7/2-2

240 0
LOOP DISPLAY

Time 15:00

ENTER LOOP NO. (LETTER & 3 DIGITS)

Baseline

```
TYPE A   F440 =    53.024 MCFH
TYPE A   T401 =   578.750 DEGF
TYPE A   T423 =   479.250 DEGF
TYPE A   T424 =   468.000 DEGF
TYPE A   F403 =    41.375 MBPD
TYPE A   F441 =   364.500 MCFH
TYPE A   F442 =   361.875 MCFH
TYPE A   T601 =  1046.000 DEGF
TYPE A   T603 =   935.000 DEGF
TYPE A
HALT!
```

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 2

Test No.	7/2-2	7/2-2	7/2-2	7/2-2	7/2-2	7/2-2	7/2-2	
Date	7-20-76	7-20	7-20	7-20	7-20	7-20	7-20	
Time	9:00	9:35	10:20	11:00	13:20	13:55	15:00	
Load [MBPD]	41.09	41.4	41.72	41.88	41.16	41.28	41.38	
Firebox east	-.9	-.88	-.9	-.9	-.9	-.9	-.9	
Firebox west	-.9	-.93	-.9	-.9	-.9	-.9	-.87	
Stack Pressure	-.78	-.78	-.79	-.78	-.78	-.75	-.73	
Plenum PT. 1	-.58	-.55	-.71	-.73	-.75	-.73	-.6	
Plenum PT. 2	-.57	-.58	-.73	-.73	-.75	-.77	-.62	
Plenum PT. 3	-.50	-.52	-.74	-.72	-.73	-.75	-.55	
C.R. Stack O_2 (%)	12.2	8.5	12.1	5.3	8.7	8.8	8.5	
Pressure in Gas Manifold	20.5	21.5	23.0	21.6	21.2	21.2	21.9	

" H_2O

BASELINE

BASELINE

REG. ADJ.

REG. ADJ.

REG. ADJ.

REG. ADJ.

BASELINE (MORE AIR THAN OTHER BASELINE)

7-21-76 0915 HRS.

HALT! TEST 7/2-3 BASELINE
240 0
LOOP DISPLAY

ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A T401 = 578.750 DEGF
TYPE A T423 = 477.750 DEGF
TYPE A T424 = 466.500 DEGF
TYPE A F403 = 42.750 MBPD
TYPE A F440 = 53.593 MCFH
TYPE A F441 = 363.750 MCFH
TYPE A F442 = 361.125 MCFH
TYPE A T601 = 1099.000 DEGF
TYPE A T603 = 950.000 DEGF
TYPE A

HALT!

7-21-76 1000 Hrs

TEST 7/2-3 BASELINE

```
HALT!
240 0
LOOP DISPLAY

ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A   T401 =  579.375 DEGF
TYPE A   T423 =  478.500 DEGF
TYPE A   T424 =  467.250 DEGF
TYPE A   F403 =   42.625 MBPD
TYPE A   F440 =   53.243 MCFH
TYPE A   F441 =  363.750 MCFH
TYPE A   F442 =  363.375 MCFH
TYPE A   T601 = 1127.000 DEGF
TYPE A   T603 =  946.000 DEGF
TYPE A

HALT!
```

7-21-76 1105 Hrs

HALT!
240 0
LOOP DISPLAY 7/2-3 REG. ADJ.

ENTER LOOP NO. (LETTER & 3 DIGITS)

TYPE A T401 = 581.250 DEGF
TYPE A T423 = 479.250 DEGF
TYPE A T424 = 467.250 DEGF
TYPE A F403 = 42.968 MBPD
TYPE A F440 = 52.850 MCFH
TYPE A F441 = 359.250 MCFH
TYPE A F442 = 358.875 MCFH
TYPE A T601 = 1110.000 DEGF
TYPE A T603 = 937.000 DEGF
TYPE A

HALT!

UNIT 2

7-21-76 TEST 7/2-3

1300 HRS 5 & 7 BOOS

T	401	579	°F
T	423	479	°F
T	424	467	°F
F	403	42.81	MBPD
F	440	52.76	MCFH
F	441	364.5	MCFH
F	442	368.2	MCFH
T	601	1249	°F
T	603	913	°F

7-21-76 TEST 7/2-3

1330 HRS 5 & 7 BOOS

T	401	579	°F
T	423	479	°F
T	424	468	°F
F	403	43.00	MBPD
F	440	53.15	MCFH
F	441	358.1	MCFH
F	442	356.0	MCFH
T	601	1218	°F
T	603	914	°F

UNIT 2

7-21-76	TEST 7/2-3	1430 HRS	2 & 11 BOOS
T 401	579	°F	
T 423	478	°F	
T 424	468	°F	
F 403	43.09	MBPD	
F 440	53.94	MCFH	
F 441	360.7	MCFH	
F 442	364.1	MCFH	
T 601	1091	°F	
T 603	950	°F	

7-21-76	TEST 7/2-3	1500 HRS	2 & 11 BOOS
T 401	580	°F	
T 423	478	°F	
T 424	468	°F	
F 403	43.12	MBPD	
F 440	53.63	MCFH	
F 441	362.2	MCFH	
F 442	362.2	MCFH	
T 601	1137	°F	
T 603	958	°F	

7-21-76	TEST 7/2-3	1545 HRS	BASELINE
T 401	580	°F	
T 423	478	°F	
T 424	468	°F	
F 403	43.59	MBPD	
F 440	53.15	MCFH	
F 441	362.6	MCFH	
F 442	358.5	MCFH	
T 601	1079	°F	
T 603	935	°F	

SUPPLEMENTAL OPERATING DATA

Location 7

Unit 2

Test No.	7/2-3	7/2-3	7/2-3	7/2-3	7/2-3	7/2-3	7/2-3	7/2-3
Date	7-21	7-21	7-21	7-21	7-21	7-21	7-21	7-21
Time	0915	1000	1105	1300	1330	1430	1500	1545
Load	42.75	42.62	42.77	42.81	43.00	43.09	43.12	43.59
Firebox east	-.91	-.90	-.91	-.90	-.92	-.93	-.93	-.90
Firebox west	-.91	-.90	-.90	-.94	-.91	-.94	-.91	-.86
Stack Pressure	-.78	-.77	-.76	-.80	-.76	-.80	-.78	.71
Plenum PT. 1	-.60	-.63	-.66	-.67	-.67	-.64	-.68	-.63
Plenum PT. 2	-.63	-.63	-.65	-.67	-.70	-.70	-.65	-.64
Plenum PT. 3	-.58	-.58	-.66	-.64	-.66	-.62	-.60	-.61
C.R. Stack O_2 (%)	8.2	6.9	3.8	4.3	4.2	2.5	2.2	3.7
Pressure in Gas Manifold	21.0	20.0	19.0	25.5	25.0	25.0	24.0	17.5

LOCATION 7

Fuel Gas Analysis

Unit 2

METHOD: Mass Spectrometry

Component	Fuel Gas Test 7/2-2
methane	58.08 mole %
ethane	6.75
propane	5.91
i-butane	.46
n-butane	1.02
pentane	.29
hexane	.30
C_6^+	.07
ethene	.67
propene	.58
butene	.69
cyclohexane	.03
benzene	.01
nitrogen	1.11
oxygen	.30
carbon dioxide	.06
water	<.01
hydrogen	23.67

TEST 7/2-1

LOCATION 7

O_2 Traverse

Date _____ Unit 2 Sample Point _____

Probe Position (inches from back wall)	O_2 (%)		CO (ppm)
6	6.9-7.3	7.1	
12	7.2-7.8	7.5	
18	7.1-7.3	7.2	
24	6.8-7.2	7.0	
30	7.4-7.7	7.55	
36	7.9-8.4	8.15	
42	8.4-8.6	8.5	
48	8.1-8.4	8.25	
54	8.5-8.7	8.6	
60	9.2-9.6	9.4	
66	10.5-11.0	10.75	
72	10.5-11.5	11.0	
78	10.0-10.5	10.25	
84	— —		
Average		8.56	

GAS TURBINE COMBINED CYCLE

Location No. 7 Unit No. 3

Unit Description GAS TURBINE COMBINED CYCLE
12.5 MW G.E. TURBINE
150 MW (515,000 lb/hr) B&W

Installation Date

Heater Rating 150 MW (512 x 10^6 Btu/hr)

Burner Description
8 BURNERS, 2 ROWS OF 4 BURNERS

Test Fuel Combinations REFINERY GAS

Fuel Temp. at Burner (°F) Ambient

Primary Air Temp. (°F) 399°C (750°F)

Comments:

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-1 Date 7-26-76 Location 7 Engr. BUENING

Unit No. 3 Fuel REF. GAS Capacity 515 KLB/HR.

Unit Type COMB. CYCLE Burner Type SPUDBURNER

	1A		2A							
1. Test No.	7/3-1		7/3-1							
2. Date	7-26		7-26							
3. Time	1945		2000							
4. Load	468K		10 MW							
5. Process Rate	—		—		—		—		—	
6. Flue Diam. or Size, ~~ft~~ in.	150"x114"		—							
7. Probe Position	BLR. EXH.		G.T. EXH.							
8. Oxygen (%)	5.9		17.5							
9. NOx (hot) read/3% O_2 (ppm)*	77	92	—							
10. NO (hot) read/3% O_2 (ppm)*	78	93	—							
11. NO_2 (hot) read/3% O_2 (ppm)*	0	1	—							
12. NO (cold) read/3% O_2 (ppm)*	100	119	37	190						
13. Carbon Dioxide (%)	8.5		1.9							
14. Carbon Monoxide (ppm) uncor/cor*	280	334	16	82						
15. Hydrocarbon (ppm) uncor/cor*	8	10	—							
16. Sulfur Dioxide (ppm) uncor/cor*	0		—							
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	88		88							
19. Dew Point Temp. (°F/°C)	78		78							
20. Atmos. Pressure (in. Hg)	29.96		29.96							
21. Relative Humidity (%)	66		66							
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

304

BASELINE PARTIC.

BASELINE PARTIC.

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-1 Date 7-27-76 Location 7 Engr. BUENING

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr.

Unit Type COMB. CYCLE Burner Type SPUDBURNER

1. Test No.	7/3-1		7/3-1		7/3-1		7/3-1		7/3-1	
2. Date	7-27-76		7-27-76		7-27-76		7-27-76		7-27-76	
3. Time	11:05		11:07		11:15		11:20		11:23	
4. Load	475		→		→		→		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(1)		(2)		(8)		(9)		(10)	
8. Oxygen (%)	5.85		17.7		4.9		6.1		2.9	
9. NOx (hot) read/3% O_2 (ppm)*	83	99	—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	81	96	—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	99	118	87	475	107	120	97.5	118	115	114
13. Carbon Dioxide (%)	9.2		1.9		9.9		8.6		10.6	
14. Carbon Monoxide (ppm) uncor/cor*	320	380	16	87	500	559	260	314	1500	1492
15. Hydrocarbon (ppm) uncor/cor*	3	4	—	—	—	—	—	—	—	—
16. Sulfur Dioxide (ppm) uncor/cor*	2	2	—	—	—	—	—	—	—	—
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	88									
19. Dew Point Temp. (°F/°C)	78									
20. Atmos. Pressure (in. Hg)	30.02									
21. Relative Humidity (%)	65%									
22.										
23.										
24.										
25.	BASELINE									
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-1 Date 7-27-76 Location 7 Engr. BUENING

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/Hr.

Unit Type COMB. CYCLE Burner Type SPUDBURNER

1. Test No.	7/3-1		7/3-1		7/3-1		7/3-2		7/3-2	
2. Date	7-27-76		7-27-76		7-27-76		7-27-76		7-27-76	
3. Time	11:26		11:30		11:35		13:35		13:40	
4. Load	475		→		→		480		480	
5. Process Rate	—		—		—		—		—	
6. Flue Diam. or Size, ft										
7. Probe Position	(7)		(12)		COMP.		(1)		(2)	
8. Oxygen (%)	4.6		5.7		4.9		5.1		17.5	
9. NOx (hot) read/3% O_2 (ppm)*	—		—		—		79	89	—	
10. NO (hot) read/3% O_2 (ppm)*	—		—		—		77	87	—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—		—		2	2	—	
12. NO (cold) read/3% O_2 (ppm)*	104	114	92	108	106	119	92	104	40.5	208
13. Carbon Dioxide (%)	9.5		9.2		9.9		8.9		2.0	
14. Carbon Monoxide (ppm) uncor/cor*	890	977	650	764	700	783	520	589	10	51
15. Hydrocarbon (ppm) uncor/cor*	—		—		—		0	0	—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—		2	2	—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	88		→		→		86		→	
19. Dew Point Temp. (°F/°C)	78		→		→		79		→	
20. Atmos. Pressure (in. Hg)	30.02		→		→		29.98		→	
21. Relative Humidity (%)	65		→		→		74		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

GT EXHAUST

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-2 Date 7-27-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr.

Unit Type COMB. CYCLE Burner Type SPUDBURNER

1. Test No.	7/3-2		7/3-2		7/3-2		7/3-2		7/3-2	
2. Date	7-27-76		7-27-76		7-27-76		7-27-76		7-27-76	
3. Time	1343		1345		1356		1355		1357	
4. Load	480		—		—		—		→	
5. Process Rate	—		—		—		—		—	
6. Flue Diam. or Size, ft										
7. Probe Position	(8)		(9)		(10)		(7)		(12)	
8. Oxygen (%)	4.1		5.7		2.9		4.65		6.05	
9. NOx (hot) read/3% O_2 (ppm)*	+		+		+		+		+	
10. NO (hot) read/3% O_2 (ppm)*	+		+		+		+		+	
11. NO_2 (hot) read/3% O_2 (ppm)*	+		+		+		✓		+	
12. NO (cold) read/3% O_2 (ppm)*	100	107	94	111	112	111	102	112	96	116
13. Carbon Dioxide (%)	9.5		8.9		10.6		9.5		8.9	
14. Carbon Monoxide (ppm) uncor/cor*	1320	1406	500	588	440	438	260	286	25	30
15. Hydrocarbon (ppm) uncor/cor*	+		+		+		+		+	
16. Sulfur Dioxide (ppm) uncor/cor*	+		+		+		+		+	
17. Smoke Spot (Bacharach)	—		—		—		✓		—	
18. Atmos. Temp. (°F/°C)	86		→		—		—		→	
19. Dew Point Temp. (°F/°C)	79		—		—		—		→	
20. Atmos. Pressure (in. Hg)	29.98		—		—		—		→	
21. Relative Humidity (%)	74		—		—		—		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 7/3 Date 7-27-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K 16S/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-2		7/3-2		7/3-2		7/3-2			
2. Date	7-27-76		7-27-76		7-27-76		7-27-76			
3. Time	1400		1452		1455		1457		1502	
4. Load	480		504		—				→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	COMPOSITE		①		②		⑧		⑨	
8. Oxygen (%)	5.05		5.0		17.25		3.6		4.9	
9. NOx (hot) read/3% O_2 (ppm)*	—		75	84	—					
10. NO (hot) read/3% O_2 (ppm)*	—		75	84	—					
11. NO_2 (hot) read/3% O_2 (ppm)*	—		0	0	—					
12. NO (cold) read/3% O_2 (ppm)*	102	115	94	106	37	190	92	95	94	105
13. Carbon Dioxide (%)	9.5		9.2		1.9		9.9		9.5	
14. Carbon Monoxide (ppm) uncor/cor*	280	316	470	529	25	129	>2000	>2000	260	291
15. Hydrocarbon (ppm) uncor/cor*	—		12	14	—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		2	2	—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	86		92		—				→	
19. Dew Point Temp. (°F/°C)	79		80		—				→	
20. Atmos. Pressure (in. Hg)	29.98		29.96		—				→	
21. Relative Humidity (%)	74		60		—				→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 7/3 Date 7-27-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-2	7/3-2	7/3-2	7/3-2	
2. Date	7-27-76	7-27-76	7-27-76	7-27-76	
3. Time	1505	1509	1512	1516	
4. Load	504	→	→	→	
5. Process Rate	—	—	—	—	
6. Flue Diam. or Size, ft	—	—	—	—	
7. Probe Position	(10)	(7)	(12)	COMP.	
8. Oxygen (%)	2.6	4.2	4.9	4.3	
9. NOx (hot) read/3% O_2 (ppm)*	—	—	—	—	
10. NO (hot) read/3% O_2 (ppm)*	—	—	—	—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—	—	—	
12. NO (cold) read/3% O_2 (ppm)*	925 90	101 108	92 103	102 110	
13. Carbon Dioxide (%)	10.8	10.2	9.5	10.1	
14. Carbon Monoxide (ppm) uncor/cor*	>2000 >2000	260 279	250 280	310 334	
15. Hydrocarbon (ppm) uncor/cor*	—	—	—	—	
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—	—	
17. Smoke Spot (Bacharach)	—	—	—	—	
18. Atmos. Temp. (°F/°C)	92	→	→	→	
19. Dew Point Temp. (°F/°C)	80	→	→	→	
20. Atmos. Pressure (in. Hg)	29.96	→	→	→	
21. Relative Humidity (%)	60	→	→	→	
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-2 Date 7-28-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr

Unit Type COMB. CYCLE Burner Type STUD BURNER

1. Test No.	7/3-2		7/3-2		7/3-2		7/3-2		7/3-2	
2. Date	7-28-76		7-28-76		7-28-76		7-28-76		7-28-76	
3. Time	0908						0920			
4. Load	444-445		—		—		—		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(1)		(2)		(7)		(8)		(9)	
8. Oxygen (%)	6.1		17.0		6.0		4.95		6.35	
9. NOx (hot) read/3% O_2 (ppm)*	87	105	—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	86	104	—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	105	127	49	220	102	122	109	122	97	119
13. Carbon Dioxide (%)	8.6%		2.1		8.2		8.6		7.7	
14. Carbon Monoxide (ppm) uncor/cor*	10	12	5	22	10	12	10	11	10	12
15. Hydrocarbon (ppm) uncor/cor*	10	12	—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	0		—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	88									
19. Dew Point Temp. (°F/°C)	77		→		→		→		→	
20. Atmos. Pressure (in. Hg)	29.99		→		→		→		→	
21. Relative Humidity (%)	62%		→		→		→		→	
22.										
23.										
24.										
25.	REGISTER ADJUSTMENT									
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 7/3-2 Date 7-28-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515K lbs/hr

Unit Type COMB. CYCLE Burner Type STUD BURNER

1. Test No.	7/3-2		7/3-2		7/3-2						7/3-2	
2. Date	7-28-76		7-28-76		7-28-76						7-28-76	
3. Time	0925										1050	
4. Load	444-454		—		—						444-456	
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	(10)		(12)		COMP.						(1)	
8. Oxygen (%)	3.9		6.1		5.5						6.0	
9. NOx (hot) read/3% O_2 (ppm)*	+		+		+						82	98
10. NO (hot) read/3% O_2 (ppm)*	+		+		+						80	96
11. NO_2 (hot) read/3% O_2 (ppm)*	+		+		+						2	2
12. NO (cold) read/3% O_2 (ppm)*	113	119	101	122	107	124					99	119
13. Carbon Dioxide (%)	9.2		7.7		8.2						8.3	
14. Carbon Monoxide (ppm) uncor/cor*	10	11	10	12	10	12					140	161
15. Hydrocarbon (ppm) uncor/cor*	+		+		+						1	1
16. Sulfur Dioxide (ppm) uncor/cor*	+		+		+						0	0
17. Smoke Spot (Bacharach)	—		—		—						—	
18. Atmos. Temp. (°F/°C)	88		—		→						90	
19. Dew Point Temp. (°F/°C)	77		—		→						78	
20. Atmos. Pressure (in. Hg)	29.99		—		→						29.99	
21. Relative Humidity (%)	62%		—		→						59	
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

BASELINE

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 7/3-2 Date 7-28-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-2		7/3-2		7/3-2		7/3-2		7/3-2	
2. Date	7-28-76		7-28-76		7-28-76		7-28-76		7-28-76	
3. Time	1055		1058		1102		1105		1108	
4. Load	444-456		→		→		→		→	
5. Process Rate	—		—		—		—		—	
6. Flue Diam. or Size, ft										
7. Probe Position	(2)		(7)		(8)		(9)		(10)	
8. Oxygen (%)	16.75		5.8		4.8		6.8		3.9	
9. NOx (hot) read/3% O_2 (ppm)*										
10. NO (hot) read/3% O_2 (ppm)*										
11. NO_2 (hot) read/3% O_2 (ppm)*										
12. NO (cold) read/3% O_2 (ppm)*	51	216	99	117	106	118	93	118	110	116
13. Carbon Dioxide (%)	2.1		8.9		9.5		8.3		9.9	
14. Carbon Monoxide (ppm) uncor/cor*	5	21	60	71	120	133	40	51	140	147
15. Hydrocarbon (ppm) uncor/cor*	—		—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	90		→		→		→		→	
19. Dew Point Temp. (°F/°C)	78		→		→		→		→	
20. Atmos. Pressure (in. Hg)	29.99		→		→		→		→	
21. Relative Humidity (%)	59		→		→		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-2 Date 7-28-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-2		7/3-2						
2. Date	7-28-76		7-28-76						
3. Time	1110		1114						
4. Load	444-456		→						
5. Process Rate									
6. Flue Diam. or Size, ft									
7. Probe Position	(12)		COMP.						
8. Oxygen (%)	6.4		5.4						
9. NOx (hot) read/3% O_2 (ppm)*	—		—						
10. NO (hot) read/3% O_2 (ppm)*	—		—						
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—						
12. NO (cold) read/3% O_2 (ppm)*	95	117	105	121					
13. Carbon Dioxide (%)	8.3		8.9						
14. Carbon Monoxide (ppm) uncor/cor*	94	116	100	115					
15. Hydrocarbon (ppm) uncor/cor*	—		—						
16. Sulfur Dioxide (ppm) uncor/cor*	—		—						
17. Smoke Spot (Bacharach)	—		—						
18. Atmos. Temp. (°F/°C)	90		→						
19. Dew Point Temp. (°F/°C)	78		→						
20. Atmos. Pressure (in. Hg)	29.99		→						
21. Relative Humidity (%)	59		→						
22.									
23.									
24.									
25.									
26.									
27.									
28.									
29.									
30.									

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-3 Date 7-29-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/Hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-3		7/3-3		7/3-3		7/3-3		7/3-3	
2. Date	7-29-76		7-29-76		7-29-76		7-29-76		7-29-76	
3. Time	0915		0918		0923		0926		0930	
4. Load	492		→		→		→		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(1)		(2)		(7)		(8)		(9)	
8. Oxygen (%)	4.8		17		4.5		3.4		5.4	
9. NOx (hot) read/3% O_2 (ppm)*	80	89	—	—	—	—	—	—	—	—
10. NO (hot) read/3% O_2 (ppm)*	77	86	—	—	—	—	—	—	—	—
11. NO_2 (hot) read/3% O_2 (ppm)*	3	3	—	—	—	—	—	—	—	—
12. NO (cold) read/3% O_2 (ppm)*	95	106	46	207	99	108	107	109	96	111
13. Carbon Dioxide (%)	8.6		2.0		9.5		10.2		8.9	
14. Carbon Monoxide (ppm) uncor/cor*	>2000	>2000	10	45	>2000	>2000	>2000	>2000	1240	1431
15. Hydrocarbon (ppm) uncor/cor*	20	22	—	—	—	—	—	—	—	—
16. Sulfur Dioxide (ppm) uncor/cor*	5	6	—	—	—	—	—	—	—	—
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	88		→		→		→		→	
19. Dew Point Temp. (°F/°C)	74		→		→		→		→	
20. Atmos. Pressure (in. Hg)	29.98		→		→		→		→	
21. Relative Humidity (%)	52		→		→		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

BASELINE TEST → REGISTERS 60%

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-3 Date 7-29-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515K lbs/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-3		7/3-3		7/3-3					7/3-3		
2. Date	7-29-76		7-29-76		7-29-76					7-29-76		
3. Time	0934		0937		0940					1025		
4. Load	492		—		→					489		
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	(10)		(12)		COMPOSITE					(1)		
8. Oxygen (%)	2.5		5.4		4.15					5.0		
9. NOx (hot) read/3% O_2 (ppm)*	—		—		—					85	96	
10. NO (hot) read/3% O_2 (ppm)*	—		—		—					82	92	
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—		—					3	3	
12. NO (cold) read/3% O_2 (ppm)*	109	106	100	115	105	112				115	129	
13. Carbon Dioxide (%)	10.6		8.9		9.2					8.9		
14. Carbon Monoxide (ppm) uncor/cor*	>2000	>2000	650	750	>2000	>2000				1540	1732	
15. Hydrocarbon (ppm) uncor/cor*	—		—		—					5	6	
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—					2	2	
17. Smoke Spot (Bacharach)	—		—		—					—		
18. Atmos. Temp. (°F/°C)	88		—		→					93		
19. Dew Point Temp. (°F/°C)	74		—		→					81		
20. Atmos. Pressure (in. Hg)	29.98		—		→					29.98		
21. Relative Humidity (%)	52		—		→					60		
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

REGISTER pp 75

MOBILE LABORATORY DATA Test No. _____

Test No. 7/3-3 Date 7-29-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-3		7/3-3		7/3-3		7/3-3		7/3-3	
2. Date	7-29-76		7-29-76		7-29-76		7-29-76		7-29-76	
3. Time	1030		1033		1037		1041		1045	
4. Load	489		—		—		—		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(2)		(7)		(8)		(9)		(10)	
8. Oxygen (%)	17.5		4.7		3.5		5.9		2.75	
9. NOx (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	44	226	102	113	107	110	99	118	112	110
13. Carbon Dioxide (%)	1.9		9.2		9.9		8.6		10.6	
14. Carbon Monoxide (ppm) uncor/cor*	5	26	1540	1701	>2000	>2000	570	679	>2000	>2000
15. Hydrocarbon (ppm) uncor/cor*	—		—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	93		—		—		—		→	
19. Dew Point Temp. (°F/°C)	81		—		—		—		→	
20. Atmos. Pressure (in. Hg)	29.98		—		—		—		→	
21. Relative Humidity (%)	60		—		—		—		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 7/3-3 Date 7-29-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lb/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-3		7/3-3			7/3-3		7/3-3	
2. Date	7-29-76		7-29-76			7-29-76		7-29-76	
3. Time	1049		1054			1154		1157	
4. Load	489		→			468		→	
5. Process Rate									
6. Flue Diam. or Size, ft									
7. Probe Position	(12)		COMPOSITE			(1)		(2)	
8. Oxygen (%)	5.6		4.5			5.5		17	
9. NOx (hot) read/3% O_2 (ppm)*	—		—			73	85	—	
10. NO (hot) read/3% O_2 (ppm)*	—		—			74	86	—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—			0	0	—	
12. NO (cold) read/3% O_2 (ppm)*	100	117	105	115		89	103	45	202
13. Carbon Dioxide (%)	8.9		9.2			8.3		1.9	
14. Carbon Monoxide (ppm) uncor/cor*	400	468	>2000	>2000		1400	1626	10	45
15. Hydrocarbon (ppm) uncor/cor*	—		—			2	2	—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		—			0	0	—	
17. Smoke Spot (Bacharach)	—		—			—		—	
18. Atmos. Temp. (°F/°C)	93		→			94		→	
19. Dew Point Temp. (°F/°C)	81		→			76		→	
20. Atmos. Pressure (in. Hg)	29.98		→			30.00		→	
21. Relative Humidity (%)	60		→					→	
22.									
23.									
24.									
25.									
26.									
27.									
28.									
29.									
30.									

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 7/3-3 Date 7-29-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-3		7/3-3		7/3-3		7/3-3		7/3-3	
2. Date	7-29-76		7-29-76		7-29-76		7-29-76		7-29-76	
3. Time	1203		1205		1208		1211		1214	
4. Load	468		—		—		—		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(7)		(8)		(9)		(10)		(12)	
8. Oxygen (%)	4.95		3.9		5.6		3.3		5.5	
9. NOx (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	80	90	80	84	87	102	85	86	90	105
13. Carbon Dioxide (%)	8.9		9.2		8.2		9.5		8.2	
14. Carbon Monoxide (ppm) uncor/cor*	>2000	>2000	>2000	>2000	1740	2034	>2000	>2000	520	604
15. Hydrocarbon (ppm) uncor/cor*	—		—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	94		—		—		—		→	
19. Dew Point Temp. (°F/°C)	82		—		—		—		→	
20. Atmos. Pressure (in. Hg)	30,00		—		—		—		→	
21. Relative Humidity (%)	60		—		—		—		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 7/3-3 Date 7-29-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lbs/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-3				7/3-3		7/3-3		7/3-3	
2. Date	7-29-76				7-29-76		7-29-76		7-29-76	
3. Time	1217				1425		1429		1433	
4. Load	4.8				492		→		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	COMPOSITE				①		②		③	
8. Oxygen (%)	4.8				4.7		17		4.3	
9. NOx (hot) read/3% O_2 (ppm)*	—				83	92	—		—	
10. NO (hot) read/3% O_2 (ppm)*	—				82	91	—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—				1	1	—		—	
12. NO (cold) read/3% O_2 (ppm)*	90	100			99	109	43	193	102	110
13. Carbon Dioxide (%)	8.6				9.5		2.0		10.2	
14. Carbon Monoxide (ppm) uncor/cor*	>2000	>2000			280	309	10	45	470	507
15. Hydrocarbon (ppm) uncor/cor*	—				2	2	—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	—				4	4	—		—	
17. Smoke Spot (Bacharach)	—				—		—		—	
18. Atmos. Temp. (°F/°C)	94				96		→		→	
19. Dew Point Temp. (°F/°C)	82				82		→		→	
20. Atmos. Pressure (in Hg)	30.00				29.99		→		→	
21. Relative Humidity (%)	60				55		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

REGISTERS 1,2,5
8070

MOBILE LABORATORY DATA Test No. _____

Test No. 7/3-3 Date 7-29-76 Location 7 Engr. HANS

Unit No. 3 Fuel REF. GAS Capacity 515 K lb/hr

Unit Type COMB. CYCLE Burner Type SPUD BURNER

1. Test No.	7/3-3		7/3-3		7/3-3		7/3-3		7/3-3	
2. Date	7-29-76		7-29-76		7-29-76		7-29-76		7-29-76	
3. Time	1438		1444		1448		1453		1455	
4. Load	492		—		—		—		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(8)		(9)		(10)		(12)		COMP	
8. Oxygen (%)	3.2		5.3		2.8		5.3		4.2	
9. NOx (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	105	106	95	109	112	111	94	108	105	112
13. Carbon Dioxide (%)	10.6		9.2		10.2		8.9		9.5	
14. Carbon Monoxide (ppm) uncor/cor*	1740	1760	160	183	310	307	100	115	280	300
15. Hydrocarbon (ppm) uncor/cor*	—		—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	96		—		—		—		→	
19. Dew Point Temp. (°F/°C)	82		—		—		—		→	
20. Atmos. Pressure (in. Hg)	29.99		—		—		—		→	
21. Relative Humidity (%)	55		—		—		—		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

BOILER ON MANUAL CONTROL OPERATING DATA

O_2 TRAVERSE BOILER EXHAUST + G.T. EXHAUST

Location 7

Unit 3

Test: Time: 14:00 Date: JULY 23, 1976

Load - Steam Flow (Red Pin) LB/HR	445,000
Air Flow × 60,000 #/hr LB/HR	516,000
Fuel Flow to Boiler (SCFH)	508000
Fuel Flow Both Turbines (SCFH)	280000
Gas Turbine A to Boiler (Load MW)	9.5
Gas Turbine B (Load MW)	9.5
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)	140,000
Feedwater Flow	512
Percent Oxygen	1.8 - 2.2 = 2.0
PRESSURES GAS TURBINE SPEED	4850 RPM
Superheater Outlet (psig)	830
Refinery Gas Burner Heater Pressure (psig)	22
FD Fan Discharge Pressure (in. H_2O)	18
Gas Turbine Exhaust Pressure (in. H_2O)	14
Windbox Pressure (in. H_2O)	12.5
Furnace Pressure (in. H_2O)	9.2
Economizer Inlet Pressure (in. H_2O)	4.0
Economizer Outlet Pressure (in. H_2O)	0.4
TEMPERATURES (°F)	
Superheated Steam	785
Water Economizer Inlet	260
Water Economizer Outlet	395
Combustion Air	707
Furnace Exit	760
Gas Economizer Inlet	715
Gas Economizer Outlet	357
Gas Turbine Exhaust	740-750

Comments: REGISTERS 60% OPEN

OPERATING DATA

Location 7 PARTIC. TEST

Unit 3

Test: 7/3-1	Time: 18:45	Date: JULY 26, 1976
Load - Steam Flow (Red Pin)	468 x 10^3 lbs/hr
Air Flow	5/6 INDIC.
Fuel Flow to Boiler (SCFH)	568650
Fuel Flow Both Turbines (SCFH)	270000
Gas Turbine A to Boiler (Load MW)	10.0
Gas Turbine B (Load MW)	7.5
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)	
Feedwater Flow	528 x 10^3 lbs/hr
Percent Oxygen	1.8
PRESSURES GT SPEED	4850 RPM
Superheater Outlet (psig)	820
Refinery Gas Burner Heater Pressure (psig)	25
FD Fan Discharge Pressure (in. H_2O)	18.5
Gas Turbine Exhaust Pressure (in. H_2O)	14.0
Windbox Pressure (in. H_2O)	12.5
Furnace Pressure (in. H_2O)	9.0
Economizer Inlet Pressure (in. H_2O)	4.0
Economizer Outlet Pressure (in. H_2O)	+.4
TEMPERATURES (°F)	
Superheated Steam	785
Water Economizer Inlet	255
Water Economizer Outlet	390
Combustion Air	710
Furnace Exit	760
Gas Economizer Inlet	715
Gas Economizer Outlet	357
Gas-Turbine Exhaust	750

Comments: REGISTERS 60% OPEN

OPERATING DATA

Location 7

Unit 3

Test: 7/3-1	Time: 11:25	Date: JULY 27, 1976
Load - Steam Flow (Red Pin)	475 K lbs/Hr.	
Air Flow	516	
Fuel Flow to Boiler (SCFH)	608500	
Fuel Flow Both Turbines (SCFH)	270000	
Gas Turbine A to Boiler (Load MW)	10.0	
Gas Turbine B (Load MW)	7.0	
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)		
Feedwater Flow	560000	
Percent Oxygen	1.8 ÷ 2.5	
PRESSURES		
Superheater Outlet (psig)	820	
Refinery Gas Burner Heater Pressure (psig)	27.5	
FD Fan Discharge Pressure (in. H_2O)	19.0	
Gas Turbine Exhaust Pressure (in. H_2O)	14.0	
Windbox Pressure (in. H_2O)	12.5	
Furnace Pressure (in. H_2O)	9.0	
Economizer Inlet Pressure (in. H_2O)	3.8	
Economizer Outlet Pressure (in. H_2O)	+.4	
TEMPERATURES (°F)		
Superheated Steam	790	
Water Economizer Inlet	260	
Water Economizer Outlet	385	
Combustion Air	715	
Furnace Exit	765	
Gas Economizer Inlet	720	
Gas Economizer Outlet	354	
Gas Turbine Exhaust	755	

Comments:

BASELINE, ALL REGISTERS 60% OPEN

OPERATING DATA

Location 7

Unit 3 REG. ADJUSTM.

Test: 7/3-2 Time: 13:40 Date: JULY 27, 1976

Load - Steam Flow (Red Pin)	480 K lbs/Hr (LOAD UNSTABLE)
Air Flow	522
Fuel Flow to Boiler (SCFH)	618550
Fuel Flow Both Turbines (SCFH)	270000
Gas Turbine A to Boiler (Load MW)	
Gas Turbine B (Load MW)	7.0
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)	10.0
Feedwater Flow	550 K lbs/Hr
Percent Oxygen	.4 ÷ 1.1
PRESSURES	
Superheater Outlet (psig)	830
Refinery Gas Burner Heater Pressure (psig)	28.0
FD Fan Discharge Pressure (in. H_2O)	19.0
Gas Turbine Exhaust Pressure (in. H_2O)	14.0
Windbox Pressure (in. H_2O)	12.5
Furnace Pressure (in. H_2O)	9.3
Economizer Inlet Pressure (in. H_2O)	3.9
Economizer Outlet Pressure (in. H_2O)	+.5
TEMPERATURES (°F)	
Superheated Steam	790
Water Economizer Inlet	260
Water Economizer Outlet	385
Combustion Air	720
Furnace Exit	765
Gas Economizer Inlet	720
Gas Economizer Outlet	355
Gas Turbine Exhaust	760

Comments: REGISTERS ON BRN. 5 FULLY OPEN
OTHER REGISTERS 60% OPEN

OPERATING DATA

Location 7

Unit 3

Test: 7/3-2	Time: 15:00	Date: JULY 27, 1976
Load - Steam Flow (Red Pin)	504000 (LOAD UNSTABLE)	
Air Flow	528000	
Fuel Flow to Boiler (SCFH)	638500	
Fuel Flow Both Turbines (SCFH)	275000	
Gas Turbine A to Boiler (Load MW)	11.0	
Gas Turbine B (Load MW)	7.0	
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)		
Feedwater Flow	560000	
Percent Oxygen	.7	
PRESSURES		
Superheater Outlet (psig)	830	
Refinery Gas Burner Heater Pressure (psig)	29.0	
FD Fan Discharge Pressure (in. H_2O)	19.0	
Gas Turbine Exhaust Pressure (in. H_2O)	14.0	
Windbox Pressure (in. H_2O)	12	
Furnace Pressure (in. H_2O)	9.3	
Economizer Inlet Pressure (in. H_2O)	4.0	
Economizer Outlet Pressure (in. H_2O)	+.4	
TEMPERATURES (°F)		
Superheated Steam	790	
Water Economizer Inlet	260	
Water Economizer Outlet	385	
Combustion Air	725	
Furnace Exit	775	
Gas Economizer Inlet	725	
Gas Economizer Outlet	355	
Gas Turbine Exhaust	763	

Comments: REGISTERS ON BRN. 1, 5, 6 FULLY OPEN
OTHER REGISTERS @ 60% OPEN

OPERATING DATA

Location 7

Unit 3

Test: 7/3-2 Time: 9:15 Date: JULY 28, 1976

Load - Steam Flow (Red Pin)	444 ÷ 454 LOAD UNSTABLE
Air Flow	516
Fuel Flow to Boiler (SCFH)	540 000
Fuel Flow Both Turbines (SCFH)	290 000
Gas Turbine A to Boiler (Load MW)	13.0
Gas Turbine B (Load MW)	8.2
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)	
Feedwater Flow	512
Percent Oxygen	2÷3
PRESSURES	
Superheater Outlet (psig)	820
Refinery Gas Burner Heater Pressure (psig)	24.8
FD Fan Discharge Pressure (in. H_2O)	19.0
Gas Turbine Exhaust Pressure (in. H_2O)	14.0
Windbox Pressure (in. H_2O)	12-0
Furnace Pressure (in. H_2O)	9-0
Economizer Inlet Pressure (in. H_2O)	3.7
Economizer Outlet Pressure (in. H_2O)	+4
TEMPERATURES (°F)	
Superheated Steam	775
Water Economizer Inlet	260
Water Economizer Outlet	392
Combustion Air	765
Furnace Exit	755
Gas Economizer Inlet	710
Gas Economizer Outlet	355
Gas Turbine Exhaust	800

Comments: REGISTER ON BURNER 1, 5, 6 100% OPEN
ALL OTHERS 60% OPEN

OPERATING DATA

Location 7

Unit 3

Test: 7/3-2 Time: 10:40 Date: JULY 28, 1976

Load - Steam Flow (Red Pin)	444 ÷ 456000 lbs/Hr.
Air Flow	516000
Fuel Flow to Boiler (SCFH)	548700
Fuel Flow Both Turbines (SCFH)	300000
Gas Turbine A to Boiler (Load MW)	14.5
Gas Turbine B (Load MW)	8.5
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)	
Feedwater Flow	512
Percent Oxygen	2.0 ÷ 2.4
PRESSURES	
Superheater Outlet (psig)	820
Refinery Gas Burner Heater Pressure (psig)	24.2
FD Fan Discharge Pressure (in. H_2O)	19.0 F.D. FAN SHUTOFF DAMPER CLOSED (TYP. FOR ALL TESTS)
Gas Turbine Exhaust Pressure (in. H_2O)	14.9
Windbox Pressure (in. H_2O)	12.7
Furnace Pressure (in. H_2O)	9.2
Economizer Inlet Pressure (in. H_2O)	3.9
Economizer Outlet Pressure (in. H_2O)	+.4
TEMPERATURES (°F)	
Superheated Steam	780
Water Economizer Inlet	260
Water Economizer Outlet	340
Combustion Air	805
Furnace Exit	755
Gas Economizer Inlet	710
Gas Economizer Outlet	355
Gas Turbine Exhaust	835

Comments: BASELINE. ALL REGISTERS 60% OPEN

OPERATING DATA

Location 7

Unit 3

Test: 7/3-3	Time: 9:10	Date: JULY 29, 1976
Load - Steam Flow (Red Pin)		492
Air Flow		516
Fuel Flow to Boiler (SCFH)		608500
Fuel Flow Both Turbines (SCFH)		285000
Gas Turbine A to Boiler (Load MW)		12.5
Gas Turbine B (Load MW)		8.0
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)		
Feedwater Flow		550000
Percent Oxygen		.2
PRESSURES		
Superheater Outlet (psig)		830
Refinery Gas Burner Heater Pressure (psig)		28.2
FD Fan Discharge Pressure (in. H_2O)		19.0
Gas Turbine Exhaust Pressure (in. H_2O)		14.5
Windbox Pressure (in. H_2O)		12.9
Furnace Pressure (in. H_2O)		7.5
Economizer Inlet Pressure (in. H_2O)		4.0
Economizer Outlet Pressure (in. H_2O)		1.4
TEMPERATURES (°F)		
Superheated Steam		795
Water Economizer Inlet		260
Water Economizer Outlet		380
Combustion Air		755
Furnace Exit		760
Gas Economizer Inlet		717
Gas Economizer Outlet		355
Gas Turbine Exhaust		797

Comments: BASELINE - ALL REGISTERS 60% OPEN

OPERATING DATA

Location 7

Unit 3

Test: 7/3-3	Time: 10:30	Date: JULY 29, 1976
Load - Steam Flow (Red Pin)		489
Air Flow		516
Fuel Flow to Boiler (SCFH)		608500
Fuel Flow Both Turbines (SCFH)		290000
Gas Turbine A to Boiler (Load MW)		12.2
Gas Turbine B (Load MW)		7.5
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)		
Feedwater Flow		544
Percent Oxygen		.3
PRESSURES		
Superheater Outlet (psig)		830
Refinery Gas Burner Heater Pressure (psig)		28.5
FD Fan Discharge Pressure (in. H_2O)		18.5
Gas Turbine Exhaust Pressure (in. H_2O)		14.0
Windbox Pressure (in. H_2O)		12.5
Furnace Pressure (in. H_2O)		9.4
Economizer Inlet Pressure (in. H_2O)		3.9
Economizer Outlet Pressure (in. H_2O)		+.4
TEMPERATURES (°F)		
Superheated Steam		785
Water Economizer Inlet		258
Water Economizer Outlet		390
Combustion Air		752
Furnace Exit		760
Gas Economizer Inlet		715
Gas Economizer Outlet		354
Gas Turbine Exhaust		793

Comments: REGISTER ADJUSTMENT. #2 5 REGIST. 80% OPEN
* FEEDWATER FLOW CHANGING WITH DRUMLEVEL. FUELFLOW CONST. THEREFORE SLIGHT LOAD VARIATION WITH BOILER IN MANUAL.

OPERATING DATA

Location 7

Unit 3

Test: 7/3-3	Time: 12:00	Date: JUL. 29, 1976
Load - Steam Flow (Red Pin)	468	
Air Flow	516	
Fuel Flow to Boiler (SCFH)	568700	* FUEL FLOW METER WAS WORKED ON @ ~ 11:00
Fuel Flow Both Turbines (SCFH)	285000	
Gas Turbine A to Boiler (Load MW)	12.0	
Gas Turbine B (Load MW)	7.5	
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)		
Feedwater Flow	528	
Percent Oxygen	.25	
PRESSURES		
Superheater Outlet (psig)	825	
Refinery Gas Burner Heater Pressure (psig)	33.5	
FD Fan Discharge Pressure (in. H_2O)	18.5	
Gas Turbine Exhaust Pressure (in. H_2O)	14	
Windbox Pressure (in. H_2O)	12.5	
Furnace Pressure (in. H_2O)	9.2	
Economizer Inlet Pressure (in. H_2O)	3.7	
Economizer Outlet Pressure (in. H_2O)	+.4	
TEMPERATURES (°F)		
Superheated Steam	776	
Water Economizer Inlet	257	
Water Economizer Outlet	390	
Combustion Air	760	
Furnace Exit	755	
Gas Economizer Inlet	706	
Gas Economizer Outlet	353	
Gas Turbine Exhaust	802	

Comments: Nº 5 BOOS REG. 5 80% OPEN. ALL OTHERS 60% OPEN

OPERATING DATA

Location 7

Unit 3

Test: 713-3 Time: 14:30 Date: JULY 29, 1976

Load - Steam Flow (Red Pin)	492
Air Flow	516
Fuel Flow to Boiler (SCFH)	598000
Fuel Flow Both Turbines (SCFH)	285000
Gas Turbine A to Boiler (Load MW)	12.2
Gas Turbine B (Load MW)	7.5
Fuel Flow to Gas Turbine A Calculated = 4 x [5/(5+6)] - (SCFH)	
Feedwater Flow	560
Percent Oxygen	.6
PRESSURES	
Superheater Outlet (psig)	825
Refinery Gas Burner Heater Pressure (psig)	28
FD Fan Discharge Pressure (in. H_2O)	18.5
Gas Turbine Exhaust Pressure (in. H_2O)	14.0
Windbox Pressure (in. H_2O)	12.2
Furnace Pressure (in. H_2O)	9.2
Economizer Inlet Pressure (in. H_2O)	3.9
Economizer Outlet Pressure (in. H_2O)	+.4
TEMPERATURES (°F)	
Superheated Steam	785
Water Economizer Inlet	258
Water Economizer Outlet	385
Combustion Air	755
Furnace Exit	769
Gas Economizer Inlet	720
Gas Economizer Outlet	354
Gas Turbine Exhaust	812

Comments: Nº 1, 2, + 5 REGISTER 80% OPEN. OTHERS 60% OPEN. ALL BURNERS IN SERVICE

LOCATION 7

Fuel Gas Analysis

Unit 3

METHOD: Mass Spectrometry

RESULTS:

Component	Concentration
methane	91.67 mole %
ethane	2.81
propane	.46
butanes	.05
nitrogen	2.71
oxygen	.57
carbon dioxide	1.60
argon	.03
water	.03
hydrogen	<.01

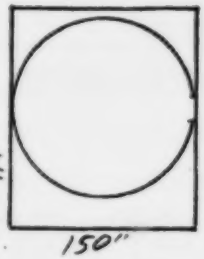
KVB, INC.

STACK DATA

Test No. 7/3-1
Engr. H. BUENING

Date 7/26/76 Location 7 Unit No. 3 Fuel REF. GAS
Load 465 K LBH K#/hr or MBtu/hr Filter No. 2 BLANK NO. 3
Sample Box No. 1 Meter Box No. 1 Probe No. 1 Probe Length 6 ft

Filter Heater Setting 4
Probe Heater Setting 2
Stack Moisture 8 %
Ambient Temperature 74 °F
Nozzle Diameter 29.98 in.
Atmospheric Pressure ____ in.Hg
Weather CLEAR
Stack Gas Pressure, Ps .1 iwg
Abs. Stack Press., AP=P +407= ____ iwga
Stack Gas Sp. Gravity, Gs ____ n.d.
Stack Area, As ____ ft²



Remarks
Final Meter: 1111.00
Initial Meter: 1027.45
83.55
4½ ft into stack

Time	Vm Meter Volume Reading	Vacuum Gage Reading	ΔP Pitot Tube Pressure	H Orfice Pressure Diff	Stack Temp.	Impinger Temperature		Filter Box Temp.	Meter Temp.
HOURS	(CF)	(iwg)	(iwg)	~~(°F)~~	(°F)	Out (°F)	In (°F)	(°F)	(°F)
1700	1027.45	7.0	.12	1.0	360	90	230	340	100
1800	1073.00	7.0		1.0	360	80	270	340	120
1830	1092.00	7.0		1.0	360	85	275	340	125
1900	1111.00	7.0		1.0	360	100	270	340	125
Total					360 °F				
Avg.					°F				
					+ 460				

Ts= 820 °R

60-13

11/20/75

PLUME OPACITY OBSERVATION RECORD

Test Run No. 7/3-1

LOCATION NO. 7 OBSERVER HANS BUENING

OWNER _____ BOILER NO. _____ CAPACITY 515 klb/hr

DATE 7/27/76 FUEL TYPE REF. GAS BURNER TYPE RING

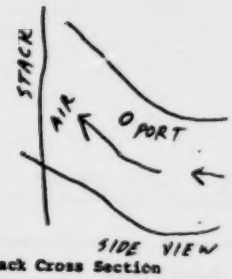
POINT OF EMISSION STACK

POINT OF OBSERVATION ~100 YARDS FROM STACK

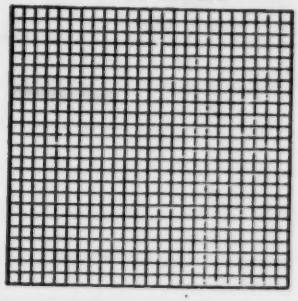
TEST No.	TEST Time am/pm	TEST Type	Test Load kǂ/hr	Opacity %	WIND Speed mph	WIND Direct.	Sky Cond.	Sun Position	Comments
*									

* THERE WERE NO VISIBLE EMISSIONS FROM STACK DURING PARTIC. TEST.

60-25



Stack Cross Section



VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: 7-26-76

Location: 7

Unit: 3

Test: 7/3-1 Personnel: _____

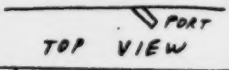
Fuel: _____

Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$



TOP VIEW

Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		33"	0.65 ↓	365	825		67.16	
		52"	0.12 ←	"	"		28.9	
		71" min	0.05 ↖	365°	"		18.62	
		90"	0.07 ←	"	"		22.04	
		109"	0.05 ↖	"	"		18.62	
							AVG. = 31.07	

6002-13

LOCATION 7

O_2 Traverse

Date JULY 23, 1976 Unit 3 Sample Point GAS TURBINE EXH.

Probe Position (inches from back wall)	O_2 (%)	CO (ppm)
1	17.5 %	0
10	17.5	
20	17.5	
30	17.5	
40	17.5	
50	17.5	
60	17.5	
70	17.5	
80	17.5	
90	17.5	
100	17.5	
110	17.5	
120	17.5	
Average		

LOCATION 7

O_2 Traverse

Date JULY 23, 1976 Unit 3 Sample Point BLR. OUTLET DUCT

Probe Position (inches from back wall)	O_2 (%)	CO (ppm)
1	6.6	0
10	6.55	0
20	6.6	0
30	6.4	0
40	6.2	100
50	5.6	100-160
60	5.5	70-260
70	5.4	50-60
80	5.2	20-40
90	4.7	60-100
100	4.4	80-120
110	4.2	60-80
120	3.8	60-140
130	3.1	60-80
Average	5.3	

AIR REGISTERS ARE AT 60% OPEN

GAS TURBINE COMBINED CYCLE

Location No. 8 Unit No. 6

Unit Description GAS TURBINE COMBINED CYCLE
35.46 MW GAS TURBINE
200 MW (1.54×10^6 lb/hr) B&W BOILER

Installation Date

Heater Rating 200 MW (682.6×10^6 Btu/hr)

Burner Description JOHN ZINK
16 BURNERS, 4 ROWS OF 4 BURNERS

Test Fuel Combinations REFINERY GAS

Fuel Temp. at Burner (°F) Ambient

Primary Air Temp. (°F) 421. °C (790°F)

Comments:

MOBILE LABORATORY DATA Test No._____

Test No. 8/1-1 Date 8-2-76 Location 8 Engr. HANS

Unit No._____ Fuel REF. GAS Capacity 1.5×10^6 lb/hr

Unit Type COMB. CYCLE Burner Type JOHN ZINK

1. Test No.	8/1-1		8/1-1		8/1-1		8/1-1		8/1-1	
2. Date	8-2-76		8-2-76		8-2-76		8-2-76		8-2-76	
3. Time	1450		1455						1520	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	①		②		⑦		⑧		⑨	
8. Oxygen (%)	1.4		17		1.7		2.0		2.1	
9. NOx (hot) read/3% O_2 (ppm)*	81	74	+		+		+		+	
10. NO (hot) read/3% O_2 (ppm)*	80	73	+		+		+		+	
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	+		+		+		+	
12. NO (cold) read/3% O_2 (ppm)*	111	102	37	166	105	98	109	103	109	104
13. Carbon Dioxide (%)	10.9		2.0		10.6		10.2		9.5	
14. Carbon Monoxide (ppm) uncor/cor*	6	6	2	9	5	5	5	5	5	5
15. Hydrocarbon (ppm) uncor/cor*	10	9	+		+		+		+	
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	+		+		+		+	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	95		—		—		—		→	
19. Dew Point Temp. (°F/°C)	78		—		—		—		→	
20. Atmos. Pressure (in. Hg)	29.94		—		—		—		→	
21. Relative Humidity (%)	48		—		—		—		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

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BASELINE + PARTIC.

AVG. $O_2 = 1.9\%$

MOBILE LABORATORY DATA

Test No. _____

Test No. 8/1-1 Date 8-2-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 × 10^6 lbs/hr

Unit Type COMB. CYCLE Burner Type JOHN ZINK

1. Test No.	8/1-1		8/1-1		8/1-1					
2. Date	8-2-76		8-2-76		8-2-76					
3. Time			1525		1530					
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(10)		(12)		COMPOSITE					
8. Oxygen (%)	2.2		2.2		2.2					
9. NOx (hot) read/3% O_2 (ppm)*	—		—		—					
10. NO (hot) read/3% O_2 (ppm)*	—		—		—					
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—		—					
12. NO (cold) read/3% O_2 (ppm)*	105	101	107	102	111	106				
13. Carbon Dioxide (%)	9.9		9.9		9.5					
14. Carbon Monoxide (ppm) uncor/cor*	3	3	4	4	3	3				
15. Hydrocarbon (ppm) uncor/cor*	—		—		—					
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—					
17. Smoke Spot (Bacharach)	—		—		—					
18. Atmos. Temp. (°F/°C)	95		→		→					
19. Dew Point Temp. (°F/°C)	78		→		→					
20. Atmos. Pressure (in. Hg)	29.94		→		→					
21. Relative Humidity (%)	48		→		→					
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 8/1-2 Date 8-3-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 × 10⁶ lbs/hr

Unit Type COMB. CYCLE Burner Type JOHN ZINK

	8/2									
1. Test No.	8/1-2		8/1-2		8/1-2		8/1-2		8/1-2	
2. Date	8-3-76		8-3-76		8-3-76		8-3-76		8-3-76	
3. Time	0915		0920		0923		0926		0930	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(1)		(2)		(7)		(8)		(9)	
8. Oxygen (%)	3.1		17		3.1		3.4		3.1	
9. NOx (hot) read/3% O_2 (ppm)*	82	82	—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	80	80	—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	101	102	32	166	102	103	100	102	104	105
13. Carbon Dioxide (%)	9.5		1.9		9.5		9.9		9.8	
14. Carbon Monoxide (ppm) uncor/cor*	8	8	13	58	8	8	8	8	9	9
15. Hydrocarbon (ppm) uncor/cor*	10	10	—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	76		→		→		→		→	
19. Dew Point Temp. (°F/°C)	72		→		→		→		→	
20. Atmos. Pressure (in. Hg)	30.09		→		→		→		→	
21. Relative Humidity (%)	82		→		→		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 8/1-2 Date 8-3-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMB. CYCLE Burner Type JOHN ZINK

	← 8/2 →				8/3
1. Test No.	8/1-2	8/1-2	8/1-2		8/1-2
2. Date	8-3-76	8-3-76	8-3-76		8-3-76
3. Time	0934	0938	0941		1103
4. Load					1.04×10^6
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	(10)	(12)	COMP.		(1)
8. Oxygen (%)	3.0	4.2	3.1		2.5
9. NOx (hot) read/3% O_2 (ppm)*	—	—	—		74 / 72
10. NO (hot) read/3% O_2 (ppm)*	—	—	—		75 / 73
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—	—		— / —
12. NO (cold) read/3% O_2 (ppm)*	105 / 105	104 / 111	106 / 107		95 / 92
13. Carbon Dioxide (%)	10.2	10.2	10.6		10.6
14. Carbon Monoxide (ppm) uncor/cor*	8 / 8	8 / 9	8 / 8		4 / 4
15. Hydrocarbon (ppm) uncor/cor*	—	—	—		3 / 3
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—		2 / 2
17. Smoke Spot (Bacharach)	—	—	—		—
18. Atmos. Temp. (°F/°C)	76	→	→		85
19. Dew Point Temp. (°F/°C)	72	→	→		74
20. Atmos. Pressure (in. Hg)	30.09	→	→		30.09
21. Relative Humidity (%)	82	→	→		60
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

B005 # 1 + 4

MOBILE LABORATORY DATA

Test No. _____

Test No. 8/1-2 Date 8-3-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMB. CYCLE Burner Type JOHN ZINK

← 8/3 →

1. Test No.	8/1-2	8/1-2	8/1-2	8/1-2	8/1-2
2. Date	8-3-76	8-3-76	8-3-76	8-3-76	8-3-76
3. Time	1107	1111	1115	1119	1123
4. Load	1.04x10^6	—	—	—	→
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	(2)	(7)	(8)	(9)	(10)
8. Oxygen (%)	17	3.0	3.2	2.6	2.3
9. NOx (hot) read/3% O_2 (ppm)*	—	—	—	—	—
10. NO (hot) read/3% O_2 (ppm)*	—	—	—	—	—
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—	—	—	—
12. NO (cold) read/3% O_2 (ppm)*	35 | 157	92 | 92	91 | 92	97 | 95	95 | 91
13. Carbon Dioxide (%)	2.1	10.6	10.6	10.6	11.0
14. Carbon Monoxide (ppm) uncor/cor*	8 | 36	4 | 4	3 | 3	4 | 4	4 | 4
15. Hydrocarbon (ppm) uncor/cor*	—	—	—	—	—
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—	—	—
17. Smoke Spot (Bacharach)	—	—	—	—	—
18. Atmos. Temp. (°F/°C)	85	—	—	—	→
19. Dew Point Temp. (°F/°C)	74	—	—	—	→
20. Atmos. Pressure (in. Hg)	30.09	—	—	—	→
21. Relative Humidity (%)	60	—	—	—	→
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

AVG. O_2 = 2.7 %

AVG. CO_2 = 10.7%

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AVG. NO (DRY @ 3% O_2) = 92 ppm

NO (WET @ 3% O_2) = 73 ppm

NO_x (WET @ 3% O_2) = 74 ppm

MOBILE LABORATORY DATA Test No. _____

Test No. 8/1-2 Date 8-3-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMB. CYCLE Burner Type JOHN ZINK

	← 8/3 →			8/4	
1. Test No.	8/1-2	8/1-2		8/1-2	8/1-2
2. Date	8-3-76	8-3-76		8-3-76	8-3-76
3. Time	1128	1135		1351	1356
4. Load × 10^6	1.04 x 10^6	→		1.08	→
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	(12)	COMP		(1)	(2)
8. Oxygen (%)	2.4	2.5		3.1	17
9. NOx (hot) read/3% O_2 (ppm)*	—	—		75 / 75	
10. NO (hot) read/3% O_2 (ppm)*	—	—		74 / 74	
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—		1 / 1	
12. NO (cold) read/3% O_2 (ppm)*	95 / 92	97 / 94		94 / 94	36 / 162
13. Carbon Dioxide (%)	10.6	10.8		9.9	2.0
14. Carbon Monoxide (ppm) uncor/cor*	4 / 4	4 / 4		5 / 5	8 / 36
15. Hydrocarbon (ppm) uncor/cor*	—	—		3 / 3	—
16. Sulfur Dioxide (ppm) uncor/cor*	—	—		0 / 0	—
17. Smoke Spot (Bacharach)	—	—		—	—
18. Atmos. Temp. (°F/°C)	85	→		88	→
19. Dew Point Temp. (°F/°C)	74	→		75	→
20. Atmos. Pressure (in. Hg)	30.09	→		30.02	→
21. Relative Humidity (%)	60	→		55	→
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 8/2-1 Date 8-3-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMB. CYCLE Burner Type JOHN ZINK

	← 8/4 →				
1. Test No.	8/1-2	8/1-2	8/1-2	8/1-2	8/1-2
2. Date	8-3-76	8-3-76	8-3-76	8-3-76	8-3-76
3. Time	1400	1404	1408	1415	1420
4. Load x 10^6	1.08	—	—	—	→
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	(7)	(8)	(9)	(10)	(12)
8. Oxygen (%)	3.3	3.3	3.2	2.5	2.4
9. NOx (hot) read/3% O_2 (ppm)*	—	—	—	—	—
10. NO (hot) read/3% O_2 (ppm)*	—	—	—	—	—
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—	—	—	—
12. NO (cold) read/3% O_2 (ppm)*	97 99	96 98	95 96	94 91	94 91
13. Carbon Dioxide (%)	9.9	9.9	9.9	10.4	10.8
14. Carbon Monoxide (ppm) uncor/cor*	4 4	6 6	6 6	4 4	4 4
15. Hydrocarbon (ppm) uncor/cor*	—	—	—	—	—
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—	—	—
17. Smoke Spot (Bacharach)	—	—	—	—	—
18. Atmos. Temp. (°F/°C)	88	—	—	—	→
19. Dew Point Temp. (°F/°C)	75	—	—	—	→
20. Atmos. Pressure (in. Hg)	30.02	—	—	—	→
21. Relative Humidity (%)	55	—	—	—	→
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

AVG. O_2 = 3.0%

AVG. CO_2 = 10.1%

345

MOBILE LABORATORY DATA

Test No. _____

Test No. 8/1-2 Date 8-3-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 x 10⁶ lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

	8/4		8/5					
1. Test No.	8/1-2		8/1-2		8/1-2		8/1-2	
2. Date	8-3-76		8-3-76		8-3-76		8-3-76	
3. Time	1430		1500		1506		1511	
4. Load	1.08		1.02		—		→	
5. Process Rate								
6. Flue Diam. or Size, ft								
7. Probe Position	COMPOSITE		①		②		⑦	
8. Oxygen (%)	2.9		6.2		17		8.0	
9. NOx (hot) read/3% O_2 (ppm)*	—		77	94	—		—	
10. NO (hot) read/3% O_2 (ppm)*	—		75	91	—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—		2	2	—		—	
12. NO (cold) read/3% O_2 (ppm)*	99	98	92	112	38	171	90	125
13. Carbon Dioxide (%)	10.6		8.2		2.0		7.4	
14. Carbon Monoxide (ppm) uncor/cor*	8	8	3	4	5	22	3	4
15. Hydrocarbon (ppm) uncor/cor*	—		0	0	—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		0	0	—		—	
17. Smoke Spot (Bacharach)	—		—		—		—	
18. Atmos. Temp. (°F/°C)	88		89		→		→	
19. Dew Point Temp. (°F/°C)	75		76		→		→	
20. Atmos. Pressure (in. Hg)	30.02		29.99		→		→	
21. Relative Humidity (%)	55		56		→		→	
22.								
23.								
24.								
25.								
26.								
27.								
28.								
29.								
30.								

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

B005 # 1, 4, 6, + 7

MOBILE LABORATORY DATA Test No. _____

Test No. 8/1-2 Date 8-3-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 × 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

8/5 →

1. Test No.	8/1-2		8/1-2		8/1-2		8/1-2		8/1-2	
2. Date	8-3-76		8-3-76		8-3-76		8-3-76		8-3-76	
3. Time	1517		1521		1525		1530		1535	
4. Load × 10^6	1.02		—		—		—		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(8)		(9)		(10)		(12)		COMP.	
8. Oxygen (%)	7.4		6.5		4.8		4.8		6.0	
9. NOx (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	—		—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	86	114	90	112	94	104	97	108	96	115
13. Carbon Dioxide (%)	7.3		7.7		8.6		8.8		8.3	
14. Carbon Monoxide (ppm) uncor/cor*	2	3	3	4	4	4	6	7	4	5
15. Hydrocarbon (ppm) uncor/cor*	—		—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	89		—		—		—		→	
19. Dew Point Temp. (°F/°C)	76		—		—		—		→	
20. Atmos. Pressure (in. Hg)	29.99		—		—		—		→	
21. Relative Humidity (%)	56		—		—		—		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

AVG. O_2 = 6.3

AVG. CO_2 = 8.0

MOBILE LABORATORY DATA Test No._____

Test No. 8/1-2 Date 8-3-76 Location 8 Engr. HANS

Unit No._____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

8/6 → 5

1. Test No.	8/1-2		8/1-2		8/1-2		8/1-2		8/1-2	
2. Date	8-3-76		8-3-76		8-3-76		8-3-76		8-3-76	
3. Time	1620		1624		1628		1632		1636	
4. Load	1.08		—		—		—		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(1)		(2)		(7)		(8)		(9)	
8. Oxygen (%)	2.3		17		2.6		2.8		2.2	
9. NOx (hot) read/3% O_2 (ppm)*	87	84	—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	85	82	—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	2	2	—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	109	105	37	166	110	108	114	113	112	107
13. Carbon Dioxide (%)	11.0		2.1		10.9		10.6		11.0	
14. Carbon Monoxide (ppm) uncor/cor*	7	7	12	54	4	4	5	5	6	6
15. Hydrocarbon (ppm) uncor/cor*	0	0	—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	91		—		—		—		→	
19. Dew Point Temp. (°F/°C)	75		—		—		—		→	
20. Atmos. Pressure (in. Hg)	29.98		—		—		—		→	
21. Relative Humidity (%)	48		—		—		—		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No. _____

Test No. 8/1-2 Date 8-3-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 × 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

5 ← 8/6 → 1

1. Test No.	8/1-2		8/1-2		8/1-2						
2. Date	8-3-76		8-3-76		8-3-76						
3. Time	1640		1644		1648						
4. Load	1.08		→		→						
5. Process Rate											
6. Flue Diam. or Size, ft											
7. Probe Position	(10)		(12)		COMPOSITE						
8. Oxygen (%)	1.6		1.6		2.2						
9. NOx (hot) read/3% O_2 (ppm)*											
10. NO (hot) read/3% O_2 (ppm)*											
11. NO_2 (hot) read/3% O_2 (ppm)*											
12. NO (cold) read/3% O_2 (ppm)*	108	100	110	102	112	107					
13. Carbon Dioxide (%)	11.0		10.9		10.9						
14. Carbon Monoxide (ppm) uncor/cor*	4	4	4	4	4	4					
15. Hydrocarbon (ppm) uncor/cor*	—		—		—						
16. Sulfur Dioxide (ppm) uncor/cor*	—		—		—						
17. Smoke Spot (Bacharach)	—		—		—						
18. Atmos. Temp. (°F/°C)	91		→		→						
19. Dew Point Temp. (°F/°C)	75		→		→						
20. Atmos. Pressure (in. Hg)	29.98		→		→						
21. Relative Humidity (%)	48		→		→						
22.											
23.											
24.											
25.											
26.											
27.											
28.											
29.											
30.											

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

AVG. O_2 = 2.2%

AVG. CO_2 = 10.9%

MOBILE LABORATORY DATA Test No._____

Test No. 8/1-2 Date 8-4-76 Location 8 Engr. HANS

Unit No._____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

	← 8/1 →		8/1-2		8/1-2		8/1-2		8/1-5	
1. Test No.	8/1-2		8/1-2		8/1-2		8/1-2		8/1-2	
2. Date	8-4-76		8-4-76		8-4-76		8-4-76		8-4-76	
3. Time	1003		1010		1014		1018		1022	
4. Load	1.1		→		→		→		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(1)		(2)		(7)		(8)		(9)	
8. Oxygen (%)	2.4		17		2.8		3.0		2.5	
9. NOx (hot) read/3% O_2 (ppm)*	85	82	+		+		+		+	
10. NO (hot) read/3% O_2 (ppm)*	84	81	+		+		+		+	
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	+		+		+		+	
12. NO (cold) read/3% O_2 (ppm)*	105	102	37	166	110	109	103	103	107	104
13. Carbon Dioxide (%)	10.6		2.0		10.2		9.9		10.5	
14. Carbon Monoxide (ppm) uncor/cor*	6	6	11	49	8	8	6	6	4	4
15. Hydrocarbon (ppm) uncor/cor*	3	3	+		+		+		+	
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	+		+		+		+	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	84		→		→		→		→	
19. Dew Point Temp. (°F/°C)	73		→		→		→		→	
20. Atmos. Pressure (in. Hg)	30.02		→		→		→		→	
21. Relative Humidity (%)	60		→		→		→		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

AVG. O_2 = 2.4%
AVG. CO_2 = 10.4%
AVG. NO = 103 ppm

350
↑ BASELINE

MOBILE LABORATORY DATA Test No._____

Test No. 8/1-2 Date 8-4-76 Location 8 Engr. HANS

Unit No._____ Fuel REF. GAS Capacity 1.5 $\times 10^6$ lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

	8/7				8/8	
1. Test No.	8/1-2	8/1-2	8/1-2		8/1-2	
2. Date	8-4-76	8-4-76	8-4-76		8-4-76	
3. Time	1026	1030	1035		1408	
4. Load	1.1	—	→		1.04	
5. Process Rate						
6. Flue Diam. or Size, ft						
7. Probe Position	(10)	(12)	COMPOSITE		(1)	
8. Oxygen (%)	1.7	1.7	2.3		3.5	
9. NOx (hot) read/3% O_2 (ppm)*	+	+	+		80	82
10. NO (hot) read/3% O_2 (ppm)*	+	+	+		79	81
11. NO_2 (hot) read/3% O_2 (ppm)*	+	+	+		1	1
12. NO (cold) read/3% O_2 (ppm)*	107 100	107 100	109 105		99	102
13. Carbon Dioxide (%)	10.6	10.9	10.6		9.9	
14. Carbon Monoxide (ppm) uncor/cor*	7 7	6 6	5 5		7	7
15. Hydrocarbon (ppm) uncor/cor*	+	+	+		2	2
16. Sulfur Dioxide (ppm) uncor/cor*	+	+	+		0	0
17. Smoke Spot (Bacharach)	—	—	—		—	
18. Atmos. Temp. (°F/°C)	84	→	→		89	
19. Dew Point Temp. (°F/°C)	73	→	→		74	
20. Atmos. Pressure (in. Hg)	30.02	→	→		29.98	
21. Relative Humidity (%)	60	→	→		50	
22.						
23.						
24.						
25.						
26.						
27.						
28.						
29.						
30.						

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

8005
#2+3

MOBILE LABORATORY DATA Test No._____

Test No. 8/1-2 Date 8-4-76 Location 8 Engr. HANS

Unit No._____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

8/8

1. Test No.	8/1-2	8/1-2	8/1-2	8/1-2	8/1-2
2. Date	8-4-76	8-4-76	8-4-76	8-4-76	8-4-76
3. Time	1414	1418	1423	1428	1435
4. Load	1.04	—	—	—	→
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	(2)	(7)	(8)	(9)	(10)
8. Oxygen (%)	17	3.5	3.75	3.75	3.25
9. NOx (hot) read/3% O_2 (ppm)*	—	—	—	—	—
10. NO (hot) read/3% O_2 (ppm)*	—	—	—	—	—
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—	—	—	—
12. NO (cold) read/3% O_2 (ppm)*	37 166	102 105	103 107	101 105	97 98
13. Carbon Dioxide (%)	2.0	10.2	10.2	10.2	10.2
14. Carbon Monoxide (ppm) uncor/cor*	6 27	5 5	5 5	4 4	4 4
15. Hydrocarbon (ppm) uncor/cor*	—	—	—	—	—
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—	—	—
17. Smoke Spot (Bacharach)	—	—	—	—	—
18. Atmos. Temp. (°F/°C)	89	—	—	—	→
19. Dew Point Temp. (°F/°C)	74	—	—	—	→
20. Atmos. Pressure (in. Hg)	29.98	—	—	—	→
21. Relative Humidity (%)	50	—	—	—	→
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

352

Data Sheet 6002-2

AVG. O_2 = 3.5 % AVG. NO = 102 ppm

AVG. CO_2 = 10.2%

MOBILE LABORATORY DATA Test No._____

Test No. 8/1-2 Date 8-4-76 Location 8 Engr. HANS

Unit No._____ Fuel REF. GAS Capacity 1.5 × 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

	8/8	
1. Test No.	8/1-2	8/1-2
2. Date	8-4-76	8-4-76
3. Time	1438	1445
4. Load × 10^6	1.04	→
5. Process Rate		
6. Flue Diam. or Size, ft		
7. Probe Position	(12)	COMPOSITE
8. Oxygen (%)	3.25	3.4
9. NOx (hot) read/3% O_2 (ppm)*	—	—
10. NO (hot) read/3% O_2 (ppm)*	—	—
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—
12. NO (cold) read/3% O_2 (ppm)*	97 98	101 103
13. Carbon Dioxide (%)	10.2	10.2
14. Carbon Monoxide (ppm) uncor/cor*	5 5	4 4
15. Hydrocarbon (ppm) uncor/cor*	—	—
16. Sulfur Dioxide (ppm) uncor/cor*	—	—
17. Smoke Spot (Bacharach)	—	—
18. Atmos. Temp. (°F/°C)	89	→
19. Dew Point Temp. (°F/°C)	74	→
20. Atmos. Pressure (in. Hg)	29.98	→
21. Relative Humidity (%)	50	→
22.		
23.		
24.		
25.		
26.		
27.		
28.		
29.		
30.		

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 8/1-2 Date 8-6-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 $\times 10^6$ lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

← 8/10 →

1. Test No.	8/1-2		8/1-2		8/1-2		8/1-2		8/1-2	
2. Date	8-6-76		8-6-76		8-6-76		8-6-76		8-6-76	
3. Time	0920		0925		0930		0934		0938	
4. Load	1.08		—		—		—		→	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	(1)		(2)		(7)		(8)		(9)	
8. Oxygen (%)	1.7		16		2.0		2.4		2.0	
9. NOx (hot) read/3% O_2 (ppm)*	81	76	—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	80	75	—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	1	1	—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	105	98	36	130	105	99	105	102	107	101
13. Carbon Dioxide (%)	10.6		2.1		10.9		10.6		10.9	
14. Carbon Monoxide (ppm) uncor/cor*	9	8	6	22	4	4	4	4	4	4
15. Hydrocarbon (ppm) uncor/cor*	6	6	—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	—		—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—		—	
18. Atmos. Temp. (°F/°C)	82		—		—		—		→	
19. Dew Point Temp. (°F/°C)	78		—		—		—		→	
20. Atmos. Pressure (in. Hg)	29.95		—		—		—		→	
21. Relative Humidity (%)	84		—		—		—		→	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

AVG. O_2 = 2.0 % BASELINE

AVG. CO_2 = 10.8%

AVG. NO = 100 ~~ppm~~

MOBILE LABORATORY DATA Test No. _____

Test No. 8/1-2 Date 8-6-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 × 10⁶ lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

	← 8/10 →				← 8/11
1. Test No.	8/1-2	8/1-2	8/1-2		8/1-2
2. Date	8-6-76	8-6-76	8-6-76		8-6-76
3. Time	0941	0944	0950		1013
4. Load × 10⁶	1.08	→	→		
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	(10)	(12)	COMPOSITE		(1)
8. Oxygen (%)	1.8	1.8	2.0		2.0
9. NOx (hot) read/3% O_2 (ppm)*	—	—	—		51 / 48
10. NO (hot) read/3% O_2 (ppm)*	—	—	—		50 / 47
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—	—		1 / 1
12. NO (cold) read/3% O_2 (ppm)*	107 / 100	105 / 98	107 / 101		66 / 63
13. Carbon Dioxide (%)	10.9	10.9	10.9		11.2
14. Carbon Monoxide (ppm) uncor/cor*	4 / 4	4 / 4	2 / 2		6 / 6
15. Hydrocarbon (ppm) uncor/cor*	—	—	—		0 / 0
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—		0 / 0
17. Smoke Spot (Bacharach)	—	—	—		—
18. Atmos. Temp. (°F/°C)	82	→	→		85
19. Dew Point Temp. (°F/°C)	78	→	→		77
20. Atmos. Pressure (in. Hg)	29.95	→	→		29.95
21. Relative Humidity (%)	84	→	→		70
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

8005
#1, 4, 6, & 7
FRESH AIR DAMPER CLOSED

MOBILE LABORATORY DATA

Test No. _____

Test No. 8/1-2 Date 8-6-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

8/11

1. Test No.	8/1-2	8/1-2	8/1-2	8/1-2	8/1-2
2. Date	8-6-76	8-6-76	8-6-76	8-6-76	8-6-76
3. Time	1018	1021	1024	1027	1030
4. Load x 10^6	1.08	—	—	—	→
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	(2)	(7)	(8)	(9)	(10)
8. Oxygen (%)	17	2.9	3.0	2.0	1.3
9. NOx (hot) read/3% O_2 (ppm)*	—	—	—	—	—
10. NO (hot) read/3% O_2 (ppm)*	—	—	—	—	—
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—	—	—	—
12. NO (cold) read/3% O_2 (ppm)*	35 | 157	66 | 66	66 | 66	67 | 63	65 | 59
13. Carbon Dioxide (%)	2.1	10.2	9.9	10.6	10.9
14. Carbon Monoxide (ppm) uncor/cor*	8 | 36	3 | 3	4 | 4	8 | 8	4 | 4
15. Hydrocarbon (ppm) uncor/cor*	—	—	—	—	—
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—	—	—
17. Smoke Spot (Bacharach)	—	—	—	—	—
18. Atmos. Temp. (°F/°C)	85	—	—	—	→
19. Dew Point Temp. (°F/°C)	77	—	—	—	→
20. Atmos. Pressure (in. Hg)	29.95	—	—	—	→
21. Relative Humidity (%)	70	—	—	—	→
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

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Data Sheet 6002-2

AVG. O_2 = 2.1 AVG. NO = 63

AVG. CO_2 = 10.6

MOBILE LABORATORY DATA Test No. _____

Test No. 8/1-2 Date 8-6-76 Location 8 Engr. HANS

Unit No. _____ Fuel REF. GAS Capacity 1.5 x 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

8/11 →

1. Test No.	8/1-2	8/1-2			
2. Date	8-6-76	8-6-76			
3. Time	1033	1038			
4. Load	108	→			
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	(12)	COMPOSITE			
8. Oxygen (%)	1.25	1.8			
9. NOx (hot) read/3% O_2 (ppm)*	—	—			
10. NO (hot) read/3% O_2 (ppm)*	—	—			
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—			
12. NO (cold) read/3% O_2 (ppm)*	65 59	67 63			
13. Carbon Dioxide (%)	10.9	10.6			
14. Carbon Monoxide (ppm) uncor/cor*	14 13	8 8			
15. Hydrocarbon (ppm) uncor/cor*	— —	— —			
16. Sulfur Dioxide (ppm) uncor/cor*	— —	— —			
17. Smoke Spot (Bacharach)	—	—			
18. Atmos. Temp. (°F/°C)	85	→			
19. Dew Point Temp. (°F/°C)	77	→			
20. Atmos. Pressure (in. Hg)	29.95	→			
21. Relative Humidity (%)	70	→			
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 8/2-1 Date 8-5-76 Location 8 Engr. HANS

Unit No. _____ Fuel GAS + OIL Capacity 1.5 × 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

1. Test No.	8/2-1		8/2-1		8/2-1		8/2-1		8/2-1	
2. Date	8-5-76		8-5-76		8-5-76		8-5-76		8-5-76	
3. Time	1345		1355		1400		1405		1410	
4. Load × 10^6 #/HR	1.03		—		—		—		→	
5. Process Rate										
6. Flue Diam. or Size, ft					*		*		*	
7. Probe Position	(1)		(2)		(7)		(8)		(9)	
8. Oxygen (%)	6.8		17		2.4		3.0		2.9	
9. NOx (hot) read/3% O_2 (ppm)*	62	79	—		—		—		—	
10. NO (hot) read/3% O_2 (ppm)*	52	66	—		—		—		—	
11. NO_2 (hot) read/3% O_2 (ppm)*	10	13	—		—		—		—	
12. NO (cold) read/3% O_2 (ppm)*	75	95	32	144	97	94	97	97	100	95
13. Carbon Dioxide (%)	11.2		1.8		10.0		9.2		9.9	
14. Carbon Monoxide (ppm) uncor/cor*	5	6	8	36	8	8	4	4	5	5
15. Hydrocarbon (ppm) uncor/cor*	2	3	—		—		—		—	
16. Sulfur Dioxide (ppm) uncor/cor*	4	5	—		—		—		—	
17. Smoke Spot (Bacharach)	2.5		—		—		—		—	
18. Atmos. Temp. (°F/°C)	91		—		—		—		→	
19. Dew Point Temp. (°F/°C)	80		—		—		—		→	
20. Atmos. Pressure (in. Hg)	29.90		—		—		—		→	
21. Relative Humidity (%)	68		→		→		→		→	
22.										
23.										
24.					GAS FUEL					
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

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Data Sheet 6002-2

BASELINE

* @ ~14:00 ONE OF THE BOILERS TRIPPED AND THE TEST UNIT WAS PUT ON GAS

MOBILE LABORATORY DATA

Test No. _____

Test No. 8/2-1 Date 8-5-76 Location 8 Engr. HANS

Unit No. _____ Fuel OIL + GAS Capacity 1.5 × 10^6 lbs/hr

Unit Type COMBINED CYCLE Burner Type JOHN ZINK

8/9

1. Test No.	8/2-1	8/2-1	8/2-1		
2. Date	8-5-76	8-5-76	8-5-76		
3. Time	1415	1420	1430		
4. Load × 10^6	1.03	→	→		
5. Process Rate					
6. Flue Diam. or Size, ft	*	*	*		
7. Probe Position	(10)	(12)	COMPOSITE		
8. Oxygen (%)	3.4	3.5	3.9		
9. NOx (hot) read/3% O_2 (ppm)*	—	—	—		
10. NO (hot) read/3% O_2 (ppm)*	—	—	—		
11. NO_2 (hot) read/3% O_2 (ppm)*	—	—	—		
12. NO (cold) read/3% O_2 (ppm)*	85 87	87 89	90 95		
13. Carbon Dioxide (%)	8.6	9.2	9.4		
14. Carbon Monoxide (ppm) uncor/cor*	4 4	3 3	4 4		
15. Hydrocarbon (ppm) uncor/cor*	—	—	—		
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—		
17. Smoke Spot (Bacharach)	—	—	—		
18. Atmos. Temp. (°F/°C)	91	→	→		
19. Dew Point Temp. (°F/°C)	80	→	→		
20. Atmos. Pressure (in. Hg)	29.90	→	→		
21. Relative Humidity (%)	68	→	→		
22.					
23.		GAS	FUEL		
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

OPERATING DATA

LOCATION 8

Test No.	8/1-1
Date	8-2-76
Time	15:00
Main Steam Flow (lbs/hr)	1080 M
Main Steam Pressure (psig)	1360
Main Steam Temperature (°F)	1004
Fuel Gas Flow (0-100%)	50.0
Air Flow (0-100%)	55.5
Oxygen (%)	1.7
Windbox Pressure (" H_2O)	6
Burner Fuel Pressure (psig) for Gas	10.2
Feedwater Pressure (psig)	1900
FD Fan Discharge Pressure (" H_2O)	46
GT Inlet Pressure (" H_2O)	40
GT Inlet Temperature (°F)	82
GT Exhaust Pressure (" H_2O)	9
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	285
Econ. Outlet Temperature (°F)	285
GT Exhaust Temperature (°F)	800
Fuel Gas (Btu)	
GT Load (MW)	27
Oil Flow (GPM)	
Stack Temperature -48- (°F)	425

50 ④	55 ③	55 ②	REG. 65 % OPEN ①
70 ⑧	20 ⑦	50 ⑥	45 ⑤
55 ⑫	50 ⑪	45 ⑩	60 ⑨
55 ⑯	45 ⑮	55 ⑭	55 ⑬

BASELINE + PARTIC.
ALL BURNERS IN SERVICE.

OPERATING DATA

LOCATION 8

	8-2
Test No.	(8/1-2) 8-2
Date	8-3-76
Time	9:30
Main Steam Flow (lbs/hr)	1.04 $\times 10^6$
Main Steam Pressure (psig)	1360
Main Steam Temperature (°F)	1000
Fuel Gas Flow (0-100%)	47
Air Flow (0-100%)	56
Oxygen (%)	3.0
Windbox Pressure (" H_2O)	7.0
Burner Fuel Pressure (psig) for Gas	9.5
Feedwater Pressure (psig)	1910
FD Fan Discharge Pressure (" H_2O)	47
GT Inlet Pressure (" H_2O)	40.5
GT Inlet Temperature (°F)	85
GT Exhaust Pressure (" H_2O)	9.2
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	285
Econ. Outlet Temperature (°F)	592
GT Exhaust Temperature (°F)	790
Fuel Gas (Btu)	
GT Load (MW)	28.0
Oil Flow (GPM)	
Stack Temperature -48- (°F)	429

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ALL BURNERS IN SERVICE

BASELINE REGISTER SETTING

OPERATING DATA

LOCATION 8

Test No.	(811-2) 8-3
Date	8-3-76
Time	11:20
Main Steam Flow (lbs/hr)	1.04×10^6
Main Steam Pressure (psig)	1360
Main Steam Temperature (°F)	1000
Fuel Gas Flow (0-100%)	47
Air Flow (0-100%)	55.5
Oxygen (%)	2-8
Windbox Pressure (" H_2O)	7.0
Burner Fuel Pressure (psig) for Gas	13.0
Feedwater Pressure (psig)	1910
FD Fan Discharge Pressure (" H_2O)	46
GT Inlet Pressure (" H_2O)	42
GT Inlet Temperature (°F)	85
GT Exhaust Pressure (" H_2O)	9.2
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	285
Econ. Outlet Temperature (°F)	285
GT Exhaust Temperature (°F)	780
Fuel Gas (Btu)	
GT Load (MW)	27.8
Oil Flow (GPM)	
Stack Temperature -48- (°F)	426

~~4~~ 3 2 ~~1~~ 1+4 OOS

8 7 6 5 REGISTERS NORMAL

12 11 10 9

16 15 14 13

OPERATING DATA

LOCATION 8

Test No.	(8/1-2) 8-4
Date	8-3-76
Time	14:00
Main Steam Flow (lbs/hr)	1.08×10^6
Main Steam Pressure (psig)	1360
Main Steam Temperature (°F)	1000
Fuel Gas Flow (0-100%)	49.5
Air Flow (0-100%)	55
Oxygen (%)	2.4
Windbox Pressure (" H_2O)	7.0
Burner Fuel Pressure (psig) for Gas	13.5
Feedwater Pressure (psig)	1910
FD Fan Discharge Pressure (" H_2O)	46
GT Inlet Pressure (" H_2O)	41
GT Inlet Temperature (°F)	85
GT Exhaust Pressure (" H_2O)	9
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	275
Econ. Outlet Temperature (°F)	591
GT Exhaust Temperature (°F)	790
Fuel Gas (Btu)	
GT Load (MW)	27.1
Oil Flow (GPM)	
Stack Temperature -48- (°F)	427

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BURNERS 6+7 OOS

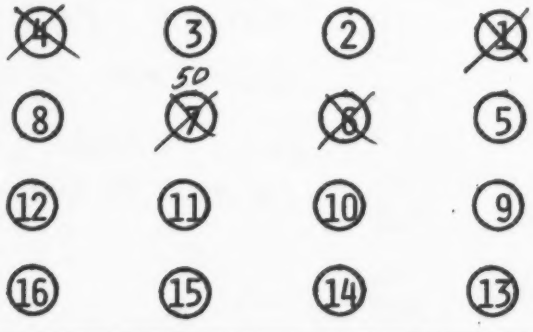
REGISTER 7 @ 50% OPEN

ALL OTHER REGISTERS LIKE BASELINE

OPERATING DATA

LOCATION 8

Test No.	(811-2) 8-5
Date	8-3-76
Time	15:20
Main Steam Flow (lbs/hr)	1.02×10^6
Main Steam Pressure (psig)	1360
Main Steam Temperature (°F)	996
Fuel Gas Flow (0-100%)	52.5
Air Flow (0-100%)	64
Oxygen (%)	4.6
Windbox Pressure (" H_2O)	11.2
Burner Fuel Pressure (psig) for Gas	19.0
Feedwater Pressure (psig)	1900
FD Fan Discharge Pressure (" H_2O)	34
GT Inlet Pressure (" H_2O)	30
GT Inlet Temperature (°F)	84
GT Exhaust Pressure (" H_2O)	16
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	275
Econ. Outlet Temperature (°F)	600
GT Exhaust Temperature (°F)	812 * SEE LOG BOOK
Fuel Gas (Btu)	
GT Load (MW)	26.9
Oil Flow (GPM)	
Stack Temperature -48- (°F)	462



4 BOOS
REG. NORMAL

OPERATING DATA

LOCATION 8

Test No.	(8/1-2) 8-6
Date	8-3-76
Time	16:15
Main Steam Flow (lbs/hr)	1.08 x 10^6
Main Steam Pressure (psig)	1380
Main Steam Temperature (°F)	996
Fuel Gas Flow (0-100%)	50
Air Flow (0-100%)	54.5
Oxygen (%)	1.6
Windbox Pressure (" H_2O)	6.5
Burner Fuel Pressure (psig) for Gas	10.5
Feedwater Pressure (psig)	1900
FD Fan Discharge Pressure (" H_2O)	45
GT Inlet Pressure (" H_2O)	40
GT Inlet Temperature (°F)	84
GT Exhaust Pressure (" H_2O)	8.5
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	280
Econ. Outlet Temperature (°F)	585
GT Exhaust Temperature (°F)	790
Fuel Gas (Btu)	
GT Load (MW)	27.8
Oil Flow (GPM)	
Stack Temperature -48- (°F)	427

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BASELINE, REGISTERS NORMAL

ALL BURNERS IN

OPERATING DATA

LOCATION 8

Test No.	(8/1-2) 8-7
Date	8-4-76
Time	10:35
Main Steam Flow (lbs/hr)	1.1×10^6
Main Steam Pressure (psig)	1360
Main Steam Temperature (°F)	996
Fuel Gas Flow (0-100%)	49.5
Air Flow (0-100%)	55
Oxygen (%)	1.6
Windbox Pressure (" H_2O)	6.5
Burner Fuel Pressure (psig) for Gas	10.5
Feedwater Pressure (psig)	1900
FD Fan Discharge Pressure (" H_2O)	46
GT Inlet Pressure (" H_2O)	40.5
GT Inlet Temperature (°F)	84
GT Exhaust Pressure (" H_2O)	9
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	280
Econ. Outlet Temperature (°F)	590
GT Exhaust Temperature (°F)	790
Fuel Gas (Btu)	930
GT Load (MW)	28.9
Oil Flow (GPM)	
Stack Temperature -48- (°F)	427

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BASELINE

ALL BURNERS IN REGIST. NORMAL

OPERATING DATA

LOCATION 8

Test No.	(811-2) 8-8
Date	8-4-76
Time	14:10
Main Steam Flow (lbs/hr)	1.04 x 10^6
Main Steam Pressure (psig)	1360
Main Steam Temperature (°F)	992
Fuel Gas Flow (0-100%)	46
Air Flow (0-100%)	54
Oxygen (%)	2.0
Windbox Pressure (" H_2O)	0
Burner Fuel Pressure (psig) for Gas	12.1
Feedwater Pressure (psig)	1910
FD Fan Discharge Pressure (" H_2O)	46
GT Inlet Pressure (" H_2O)	40
GT Inlet Temperature (°F)	84
GT Exhaust Pressure (" H_2O)	9
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	280
Econ. Outlet Temperature (°F)	585
GT Exhaust Temperature (°F)	785
Fuel Gas (Btu)	930
GT Load (MW)	27.9
Oil Flow (GPM)	
Stack Temperature -48- (°F)	426

④ ~~③~~ ~~②~~ ① REGISTERS NORMAL

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OPERATING DATA

LOCATION 8

Test No.	(8/1-2) 8-10
Date	8-6-76
Time	9:00
Main Steam Flow (lbs/hr)	1.08×10^6
Main Steam Pressure (psig)	1360
Main Steam Temperature (°F)	1000
Fuel Gas Flow (0-100%)	51
Air Flow (0-100%)	54.5
Oxygen (%)	1.1 ÷ 1.3
Windbox Pressure (" H_2O)	6.9
Burner Fuel Pressure (psig) for Gas	11
Feedwater Pressure (psig)	1900
FD Fan Discharge Pressure (" H_2O)	47
GT Inlet Pressure (" H_2O)	41
GT Inlet Temperature (°F)	85
GT Exhaust Pressure (" H_2O)	9
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	272
Econ. Outlet Temperature (°F)	570
GT Exhaust Temperature (°F)	795
Fuel Gas (Btu)	945
GT Load (MW)	28
Oil Flow (GPM)	
Stack Temperature -48- (°F)	427

④ 47	③ 55	② 50	① 45
⑧ 54	⑦ 50	⑥ 48	⑤ 44
⑫ 44	⑪ 41	⑩ 45	⑨ 60
⑯ 52	⑮ 46	⑭ 63	⑬ 55

BASELINE, GAS

OPERATING DATA

LOCATION 8

Test No.	(8/1-2) 8-11
Date	8-6-76
Time	10:15
Main Steam Flow (lbs/hr)	1.08 $\times 10^6$
Main Steam Pressure (psig)	1410
Main Steam Temperature (°F)	1000
Fuel Gas Flow (0-100%)	49
Air Flow (0-100%)	64
Oxygen (%)	1.5
Windbox Pressure (" H_2O)	6
Burner Fuel Pressure (psig) for Gas	18
Feedwater Pressure (psig)	1900
FD Fan Discharge Pressure (" H_2O)	46
GT Inlet Pressure (" H_2O)	41
GT Inlet Temperature (°F)	84
GT Exhaust Pressure (" H_2O)	9
Windbox Temperature (°F)	
Econ. Inlet Temperature (°F)	274
Econ. Outlet Temperature (°F)	586
GT Exhaust Temperature (°F)	795
Fuel Gas (Btu)	949
GT Load (MW)	27.9
Oil Flow (GPM)	
Stack Temperature -48- (°F)	428

(4) (3) (2) (1)

(8) (7) (6) (5)

(12) (11) (10) (9)

(16) (15) (14) (13)

REGISTERS NORM.
FRESH AIR DAMPERS CLOSED.

OPERATING DATA

SPLIT FUEL LOCATION 8 [illegible] PARTIC. + ANDERSON

Test No.	8/2-1
Date	8-5-76
Time	12:00
Main Steam Flow (lbs/hr)	1.03×10^6
Main Steam Pressure (psig)	1380
Main Steam Temperature (°F)	986
Fuel Gas Flow (0-100%)	12
Air Flow (0-100%)	60
Oxygen (%)	3.5 ÷ 3.8
Windbox Pressure (" H_2O)	9
Burner Fuel Pressure (psig) for Gas	6.5
Feedwater Pressure (psig)	1900
FD Fan Discharge Pressure (" H_2O)	37
GT Inlet Pressure (" H_2O)	32
GT Inlet Temperature (°F)	84
GT Exhaust Pressure (" H_2O)	13.5
Windbox Temperature (°F)	615 * FRESH AIR DAMPERS EAST OPEN 35%
Econ. Inlet Temperature (°F)	280
Econ. Outlet Temperature (°F)	595 ÷ 600
GT Exhaust Temperature (°F)	780
Fuel Gas (Btu)	945
GT Load (MW)	25
Oil Flow (GPM)	8 GAL/5 SEC = 96 GPM
Stack Temperature -48- (°F)	453

50 (4) O	55 (3) O	50 (2) O	45 (1) O
55 (8) O	50 (7) G	50 (6) G	45 (5) O
45 (12) O	40 (11) O	45 (10) O	60 (9) O
50 (16) G	45 (15) G	60 (14) G	55 (13) G

BRN. 5 & 8 KEEP TRIPPING BECAUSE OF CONTROL PROBLEM

LOST 10:20 ↓ 11:15 11:50 12:28

LIT 10:35 ↓ 11:20 11:55 12:33

G = GAS
O = OIL

LOCATION 8

FUEL GAS ANALYSES

Component	Concentration
methane	77.65 mole%
ethane	1.89
propane	.76
iso butane	.16
n-butane	.24
pentanes	.03
C_6+	.09
ethene	.67
propene	.11
nitrogen	.28
carbon dioxide	.81
hydrogen	17.31

FUEL OIL ANALYSES

SPECIFIC GRAVITY, 60/60°F.	0.8756
CARBON	80.14%
HYDROGEN	11.80%
OXYGEN	7.93%
SULFUR	0.109%
NITROGEN, PPM	171
VISCOSITY, SAY. UNIV. @ 60°F.	43.2 sec.
HEAT OF COMBUSTION, BTU/LB (GROSS)	19,697
" " BTU/LB (NET)	18,482

PARTICULATE EMISSION CALCULATIONS Method 5 — Test No. 8-1

Test No. 8-1-1 Date 8-2-76 Location ____ Engr. BUENING

Unit No. 6 Fuel REF. GAS Load 1.08 x 10⁶ LBS/P/H

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 29.94 in. Hg

Tot. Liquid Collected, V_{1c} 411.1 ml Total Particulate, M_n 9.3 m gm ✓

Velocity Head, ΔP .84 iwg Stack Temp., Ts 898 °R Stack Area, As 7 x 22 (154) ft^2

Sample Volume, Vm 72.21 ft^3 Stack Press., Psg -.15 iwg Excess O_2, XO_2% 2.2 %

Orifice Press. Diff., H .82 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 120 min Nozzle Diameter, Dn 1/4 in.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$ — 72.86 SCF
2. Water Vapor $Vw_{std} = 0.0474\ V_{1c}$ — 19.49 SCF
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) — .2122 N.D.
4. Concentration
   a. $C = 0.0154\ Mn/Vm_{std}$ — .00198 grains/DSCF ✓
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ — 2.834×10^{-7} lb/DSCF ✓
   c. $C = Eq.\ 4b \times 16.018 \times 10^3$ — 4.539×10^{-3} grams/DSCM ✓
5. Abs. Stack Press. $Ps = P_{bar} \times 13.6 + Psg$ — 407.034 in. w abs.
6. Stack Gas Speed $Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ (144.41; 27.46; .99) — 3926.1 ft/min
7. Stack Gas Flow Rate @ 70°F
   a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$ — 356,876 WSCF/min
   b. $Qsd = Eq.\ 7a \times (1. - Eq.\ 3)$ — 281,147 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 — 4.781 lb/hr ✓
9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ — 111.76 N.D.
10. Emission
   a. E = Eq. 4b x Fe x Eq. 9 — 2.768×10^{-5} lb/MMBtu ✓
   b. E = Eq. 4c x Fm x Eq. 9 x 1000 — 1.19 ng/joule ✓
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ — 96.87 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	~~87.4~~ 8.746	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS
Modified Method 5

Test No. 8/1-1

Test No. 8/1-1 Date 8-2-76 Location _____ Engr. B.

Unit No. 6 Fuel Ref. Gas Load 1.08 x 10^6 lbs/Hr.

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} 29.94 in. Hg

Tot. Liquid Collected, V_{lc} 411.1 ml Total Particulate, M_n 36.6 m gm ✓

Velocity Head, ΔP .84 iwg Stack Temp., Ts 898 °R Stack Area, As 154 ft^2

Sample Volume, Vm 72.21 ft^3 Stack Press., Psg -.15 iwg Excess O_2, XO_2% 2.2 %

Orifice Press. Diff., H .82 iwg Stack Gas Sp. Gravity, Gs 1 n.d.

Sample Time, θ 120 min Nozzle Diameter, Dn 1/4 in.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	72.36	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	19.49	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.2122	N.D.
4. Concentration a.	$C = 0.0154\ Mn/Vm_{std}$	.00779	grains/DSCF ✓
b.	$C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.115×10^{-6}	lb/DSCF ✓
c.	$C = \text{Eq. 4b} \times 16.018 \times 10^3$	1.786×10^{-2}	grams/DSCM ✓
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	407.034	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	3926.1	ft/min
7. Stack Gas Flow Rate @ 70°F a.	$Qsw = \text{Eq. 6} \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	356,876	WSCF/min
b.	Qsd = Eq. 7a x (1. - Eq. 3)	281,197	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	18.81	lb/hr ✓
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	111.76	N.D.
10. Emission a.	E = Eq. 4b x Fe x Eq. 9	1.089×10^{-2}	lb/MMBtu ✓
b.	E = Eq. 4c x Fm x Eq. 9 x 1000	4.68	ng/joule ✓
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	96.87	%

		Oil	Gas	Coal
Fe	SC Feet/10^4 Btu	92.2	87.4	98.2
Fm	SC Meters/10^4 joules	0.002475	0.002346	0.002636

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS Test No. 8/2-1

Method 5

Test No. 8/2-1 Date 8/5/76 AM Location _____ Engr. HANS B.

Unit No. 6 Fuel OIL & R.G. Load 1.05 x 10^6 lbs/Hr.

Pitot Factor, Ps .84 Barometric Pressure, P_{bar} 29.92 in. Hg

Tot. Liquid Collected, V_{lc} 330.5 ml Total Particulate, M_n 11.1 m gm

Velocity Head, ΔP 1.0 iwg Stack Temp., Ts 936 °R Stack Area, As 154 ft^2

Sample Volume, Vm 89.95 ft^3 Stack Press., Psg -.27 iwg Excess O_2, XO_2% 6.8 %

Orifice Press. Diff., H 1.25 iwg Stack Gas Sp. Gravity, Gs 1.0 n.d.

Sample Time, θ 120 min Nozzle Diameter, Dn .25 in.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	90.16 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	15.67 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.1481 N.D.
4. Concentration a.	$C = 0.0154\ Mn/Vm_{std}$	.001896 grains/DSCF
b.	$C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	2.7147×10^{-7} lb/DSCF
c.	C = Eq. 4b x 16.018×10^3	4.348×10^{-3} grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	406.64 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	4473.62 ft/min
7. Stack Gas Flow Rate @ 70°F a.	$Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	389,758 WSCF/min
b.	Qsd = Eq. 7a x (1. - Eq. 3)	332,035 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	5.408 lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	148.23 N.D.
10. Emission a.	E = Eq. 4b x Fe x Eq. 9	3.638×10^{-3} lb/MMBtu
b.	E = Eq. 4c x Fm x Eq. 9 x 1000	1.564 ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	102.2 %

	Oil	Gas	Coal
Fe ◊SC Feet/10^4 Btu	92.2	87.4	98.2
Fm ◊SC Meters/10^4 joules	0.002475	0.002346	0.002636

90.4 ≠

.002427 ≠

Values used for split fuel.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS (Modified Meth. 5) Test No. 8/2-1

Test No. 8/2-1 Date 8-5-76 Location _____ Engr. K.

Unit No. 6 Fuel 0.1 % Ref. Gr. Load 1.05 x 10^6 lbs/Hr

Pitot Factor, Ps .84 Barometric Pressure, P_{bar} 29.92 in. Hg

Tot. Liquid Collected, V_{lc} 330.5 ml Total Particulate, M_n 75.95 m gm

Velocity Head, ΔP 1.0 iwg Stack Temp., Ts 936 °R Stack Area, As 13.4 ft^2

Sample Volume, Vm 89.95 ft^3 Stack Press., Psg -.27 iwg Excess O_2, XO_2 % (6.8) %

Orifice Press. Diff., H 1.25 iwg Stack Gas Sp. Gravity, Gs 1.0 n.d.

Sample Time, θ 120 min Nozzle Diameter, Dn .25 in.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$ — 90.16 SCF
2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ — 15.67 SCF
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) — .1481 N.D.
4. Concentration
   a. $C = 0.0154\ Mn/Vm_{std}$ — .01297 grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ — 1.85715×10^{-4} lb/DSCF
   c. C = Eq. 4b x 16.018 x 10^3 — 2.975×10^{-2} grams/DSCM
5. Abs. Stack Press. $Ps = P_{bar} \times 13.6 + Psg$ — 406.64 in. w abs.
6. Stack Gas Speed $Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$ — 4473.62 ft/min
7. Stack Gas Flow Rate @ 70°F
   a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$ — 389,758 WSCF/min
   b. Qsd = Eq. 7a x (1. - Eq. 3) — 332,035 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 — 37.003 lb/hr
9. XO_2 factor $XO_2 f = 2090/(20.9 - XO_2\%)$ — (148.23) N.D.
10. Emission
    a. E = Eq. 4b x Fe x Eq. 9 — 2.489×10^{-2} lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 — 10.707 ng/joule
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ — 102.2 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test No. 8-1-1 (~~Inlet~~, ~~Outlet~~) STACK
Box No. 1
Test Description:

Location
Test Date 8-2-76

Dry Gas Meter Vol (ft3)
Final 1183.56
Initial 1111.35
Total 72.21

Impinger Water Vol (ml)

	1	2	3	Total	
Final	392	200	1	593	662.6
Initial	100	100	0	200	644.5
Δ Vol	292	100	1	393	18.1

				200 ml	200 ml	200 ml	Filter No.	Blank No.
Beaker No.	1	2	4	3	11	12	1	2
Date Weighed	8/2/76	→	→	→	→	→	→	→
Tare Wt. 1	100.0953	101.6260	99.2646	101.4092	99.8089	100.9701	.8011	.8483
2	100.0953	101.6262	99.2645				.8011	.8483
3	100.0954	101.6261	99.2644				.8011	.8483
4								
5								
6								
Avg	100.0953	101.6260	99.2645					
Bottle No.	1 & 2	3	4	OLD BLANK	NEW BLANK	BLANK H_2O	.8011	.8423
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	[redacted] (Acetone)		[redacted]		
Rinse (ml)	950 200 150 150 150 150	200 125 325	225					
Date Weighed or 250 Bake)	8/4/76	8/3/76	8/3/76	8/3/76	8/3/76	8/3/76	8/3/76	8/3/76
Final Wt. 250 1	100.1200	101.6330	99.2707	101.4127	99.8098	100.9707	.8047	.8483
2	100.1199	101.6330	99.2707				.8048	.8484
3	100.1199	101.6331	99.2706				.8048	.8483
4								
5								
6								
Avg	100.1199	101.6331	99.2707				.8048	.8483
Residue Wt Final 250 Tare)	.0246	.0071	.0062	.0035	.0009	.0006	.0037	0
Date Weighed or 650 Bake)								
Final Wt. 650 1								
2								
3								
4								
5								.0062
6								-.0006
Avg								+.0037
Residue Wt. Final 650 Tare)								

THIS ACETONE IS IN A 5 GAL. METAL PAIL. CONTAMINATED

NEW BOTTLED ACETONE

	Method 5	Method 5 M. 5
Fil	0.0037	.0093
Probe Acc	.0071	.0246
Acc + H2O Blank	-.0015	.0062 PH2
	.0093	-.0035
		.0366

Comments: OLD ACETONE WAS CHECKED (CONFIRM) TO MAKE SURE IT WAS CONTAMINATED. ONLY THE NEW ACETONE WAS USED AS A RINSE ON THESE TESTS.

PARTICULATE CALCULATION SHEET

Test No. 8/2-1 (~~Inlet, Outlet~~) STACK
Box No. 1
Test Description: OIL BASELINE

Location
Test Date 8/5/76 AM

Dry Gas Meter Vol (ft3)
Final 1331.43
Initial 1241.48
Total 89.95

330.5 ml

Impinger Water Vol (ml)

	1	2	3	Total	
Final	400	108	0	508	667.5
Initial	100	100	0	200	645.0
Δ Vol	300	8	0	308	22.5

		525 ml	275	IMP. H_2O		Filter No.	Blank No.
Beaker No.	5	6	7	8		2	3
Date Weighed	8/2/76	→	→	→		8/2/76 →	
Tare Wt. 1	98.9369	100.4834	104.0062	99.3371		.8483	.8137
2	98.9369	100.4838	104.0061	99.3371		.8483	.8137
3	98.9369	100.4834	104.0063	99.3370		.8483	.8137
4							
5							
6							
Avg	98.9369	100.4837	104.0062	99.3371		.8483	.8137
Bottle No.	5 & 6	7	8	5 & 6			
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	~~Cyclone (Acetone)~~	Flask (Dry)		
Rinse (ml)	200 ml 75 ml 125 ml (400)	200 ml 125 ml 200 ml	200 ml 75 ml	200 ml 75 150 (425)			
Date Weighed or 250 Bake)	8/6/76					→	
Final Wt. 250 1	98.9773	100.4869	104.0106	99.3614		.8577	.8137
2	98.9776	100.4872	104.0108	99.3615		.8576	.8137
3	98.9777	100.4873	104.0109	99.3617		.8577	.8137
4							
5							
6							
Avg	98.9776	100.4872	104.0108	99.3616		.8577	.8137
Residue Wt Final 250 Tare)	.0407	.0033	.0046	.0245		.0094	0
Date Weighed or 650 Bake)		H_2O Blank				~~.0094~~	
Final Wt. 650 1							
2		.0006/200 ml					
3							
4		Acetone Blank					
5		.0009/200 ml					
6							
Avg							
Residue Wt. Final 650 Tare)							

Comments: 5 & 8 IMP H_2O .825 ml Rinse

.0407
.0245
.0652 TOTAL

Meth. 5	Modif. Meth
.0094	.0111
.0033	.0407
-.0016	.0245
	.0046
.0111	-.00495
	.07595

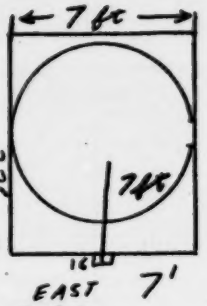
KVB, INC.

STACK DATA

Test No. 8-1-1
Engr. BUENING

Date 8-2-76 Location 8 Unit No. _____ Fuel REF. GAS
Load 1.08 × 10⁶ K#/hr or MBtu/hr Filter No. 1 BLANK 2
Sample Box No. 1 Meter Box No. 1 Probe No. 3 Probe Length 9'

Filter Heater Setting 7~5
Probe Heater Setting 3
Stack Moisture _____ %
Ambient Temperature 95 °F
Nozzle Diameter 1/4 in.
Atmospheric Pressure 29.94 in.Hg
Weather CLOUDY - SPRINKLES (RAIN)
Stack Gas Pressure, Ps -.15 iwg
Abs. Stack Press., AP=P +407= _____ iwga
Stack Gas Sp. Gravity, Gs _____ n.d.
Stack Area, As 7×22' ft²



Remarks
Final Meter: 1183.56
Initial Meter: 1111.35
TOTAL 72.21

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
1720	1111.35	5.5	.85	.82	420	65	175	300	110
1750	1130.00	5.5	.83	.82	435	60	255	320	118
1820	1149.00	5.5	.84	.82	440	65	290	355	125
1850	1166.00	5.5	.83	.82	445	70	290	340	130
1920	1183.56	5.75	.83	.82	450	70	275	330	130
2.0 HRS									
Total	72.21				438 °F				
Avg.		350			°F				
		310			+ 460				
		330		Ts=	898 °R				
		340							
		340							

60-13

11/20/75

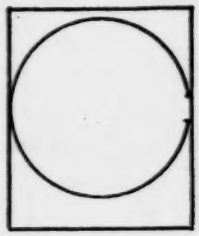
K V B. INC.

STACK DATA

Test No.
Engr. H. BUENING

Date 8/5/76 AM Location 8 Unit No. Fuel OIL + REF. GAS
Load 1.03 x 10^6 K#/hr or MBtu/hr Filter No. 2 BLANK 3
Sample Box No. 1 Meter Box No. 1 Probe No. 3 Probe Length ~~X~~ 4

Filter Heater Setting
Probe Heater Setting
Stack Moisture 12 %
Ambient Temperature 100 °F
Nozzle Diameter .25 in. diam.
Atmospheric Pressure 29.92 in.Hg
Weather CLOUDY
Stack Gas Pressure, Ps -.27 iwg(-)
Abs. Stack Press., AP=P_s +407= iwga
Stack Gas Sp. Gravity, Gs 1 n.d.
Stack Area, As 154 ft^2



Remarks
Final Meter: 1331.43
Initial Meter: 1241.48

89.95

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
1100	1241.48	9.5	1.0	1.25	465	82	120	360	110
1115	1253.5	9.5	1.0	1.25	470	70	260	320	110
1130	1265.2	9.0	1.0	1.25	470	70	250	320	118
1145	1275.8	9.0	1.0	1.25	480	76	280	320	125
1200	1287.5	9.0	1.0	1.25	480	75	265	320	130
1215	1298.6	9.0	1.0	1.25	480	78	275	330	140
1230	1309.6	9.0	1.0	1.25	480	80	280	310	145
1245	1320.5	8.5	1.0	1.25	480	80	265	325	150
1300	1331.43	8.5	1.0	1.25	480	75	250	320	150
Total	89.95				476 °F				
Avg.					°F				
					+ 460				

Ts= 936 °R

TEMP. PROBE

°F 350 350
320 335
320 320
335
340
335

60-13
11/20/75

ANDERSON CASCADE IMPACTOR

K V B, INC.

Test No. 812-1
Engr. BUENING

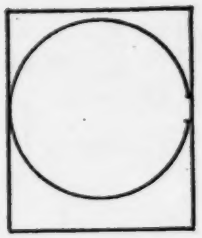
STACK DATA

Date 8/5/76 Location 8 Unit No. _____ Fuel OIL

Load 1.05 x 10^6 K#/hr or MBtu/hr Filter No. 1

Sample Box No. 2 Meter Box No. 2 Probe No. ____ Probe Length 65" IN STACK

Filter Heater Setting 0
Probe Heater Setting 0
Stack Moisture 12 %
Ambient Temperature 100 °F
Nozzle Diameter 1/4 in.
Atmospheric Pressure 29.92 in.Hg
Weather HOT HUMID LITE CLOUDS
Stack Gas Pressure, Ps -.27 iwg
Abs. Stack Press., AP=P_s+407=____ iwga
Stack Gas Sp. Gravity, Gs____ n.d.
Stack Area, As 154 ft^2



Remarks
Final Meter: 5547.61
Initial Meter: 5523.27
24.34

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (^oF)	Stack Temp. (^oF)	Impinger Temperature Out (^oF)	Impinger Temperature In (^oF)	Filter Box Temp. (^oF)	Meter Temp. (^oF)
1117	5523.27	13	1.0	.85					
1120	5525.00	STOPPED							
1131	5525.00	12	1.0	1.1					100
1142	5535.00	14	1.0	1.19					100
1152	5544.00	14	1.0	1.18	475				
1157	5547.61	14	1.0	1.18					100
Total					475 ^oF				
Avg.					^oF				
					+ 460				

Ts= 935 ^oR

60-13

11/20/75

8/5/76 A.M.

ANDERSEN CASCADE IMPACTOR DATA

Test No. 8/2-1 Location 8 Owner

Impactor No. 622 Nozzle Size 1/4 in. Filter No. 1 - BACKUP

Stack Temperature 475 °F Impactor Flow Rate CFM

FILTER Plate	Tare (g)	Final (g)	Net (g)	%	Cum. %	ECD (μ)
1	.1911	.1891	-.0013		100.0	
2	.1819	.1802	-.0017			
3	.1976	.1960	-.0016			
4	.1870	.1873	+.0003			
5	.1965	.1951	-.0014			
6	.1915	.1911	-.0004			
7	.1991	.1979	-.0012			
8	.1865	.1866	+.0001			
Back Up Filter 1	.1844	.1835	-.0009			

BAD TEST

Data Sheet 6002-5

PLUME OPACITY OBSERVATION RECORD

Test Run No. 8/2-1

LOCATION NO. 8 OBSERVER HANS

OWNER _____ BOILER NO. _____ CAPACITY 1.5×10^6 klb/hr

DATE 8-5-76 FUEL TYPE SPLIT FUEL BURNER TYPE J. ZINK

POINT OF EMISSION STACK

POINT OF OBSERVATION 150 YARDS TO WEST OF STACK

TEST 8/2-1			Test		WIND				
No.	Time am/pm	Type	Load kǂ/hr	Opacity %	Speed mph	Direct.	Sky Cond.	Sun Position	Comments
	11:00	NO VISIBLE PARTIC. TEST							
	11:05								
	11:10								
	11:15								
	11:20								
	11:25								
	11:30	WAS							
	11:35	DURING							
	11:45								
	11:50	THERE							
		EMISSION							

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: AUG. 2, 1976 _____

Location: 8 _____

Unit: _____ _____

Test: 8/1-1 Personnel: _____

Fuel: _____ _____

Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

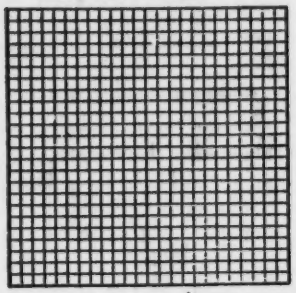
Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_g M_s}\right]^{1/2}$$

WEST PORT

DUCT 7'x22'.

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		12"	.9	425	885			
		24	1.2					
		36	1.2					
		48	.72					
		60	.74					
		72	.72					
		84	.78					
		96	.6					

AVE. .852

AVE. VELOCITY 96.27

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: AUG. 2, 1976 _____

Location: 8 _____

Unit: _____ _____

Test: 8/1-1 Personnel: _____

Fuel: _____ _____

Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

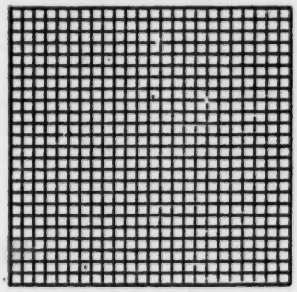
Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

EAST PORT

DUCT 7' x 22'

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
14:30		12"	.72	425	885		73.2	
		24"	1.4				102.07	
		36"	1.1					
		48"	.66					
		60"	.73					
		72"	.68					
		84"	.88					
		96"	.6	↓				
		108"	—					

AVE .846

AVE. VELOCITY 79.35

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: _____ BASELINE

Location: 8 _____

Unit: _____ _____

Test: 8/2-1 Personnel: _____

Fuel: SPLIT FUEL _____

Barometric Press. (in. Hg): 29.92

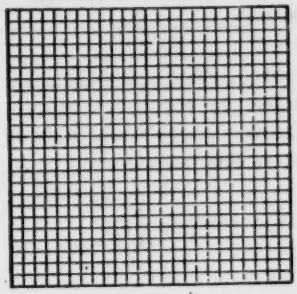
Absolute Static Press. in Stack (in. Hg): 29.90 (P_s)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

WEST PORT

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		12"	1.1	453				
		24"	1.35					
		36"	1.5					
		48"	1.3					
		60"	1.1					
		72"	.86					
		84"	1.25					
		96"	1.1					
		108"	1.0					

1.17

6003-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: _____ BASELINE

Location: 8 _____

Unit: _____ _____

Test: 8/2-1 Personnel: _____

Fuel: SPLIT FUEL _____

Barometric Press. (in. Hg): _____

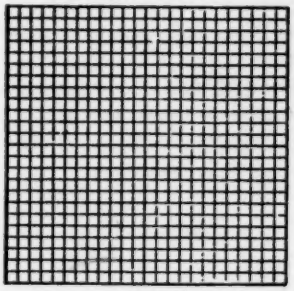
Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_g M_s}\right]^{1/2}$$

EAST PORT

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_S	Molecular Wt. M_S	Velocity (ft/sec) V_S	O_2 Conc. (% Dry)
		12"	1.5	453				
		24"	1.7					
		36"	1.2					
		48"	.85					
		60"	.65					
		72"	.9					
		84"	.86					
		96"	.9					
		108"	—					
			1.07					

6003-13

ROTARY KILN DESIGN DATA

Location No. 9 Unit No. 1

Unit Description

THE UNIT IS A WET PROCESS ROTARY KILN WITH THE SLURRY HAVING A MOISTURE CONTENT OF APPROX. 30%

Installation Date	1962
Process Capacity	8.16×10^5 kg/day (900 tons/d)
Burner Description	SPUD BURNER
Test Fuel	N. G.
Combustion Air Temperature at Burner	900 - 930 °F
Length of Kiln	450 ft.
Diameter of Kiln	12 ft.

Comments:

MOBILE LABORATORY DATA

Test No. _____

Test No. 9-1 Date 8-11-76 Location 9 Engr. HANS

Unit No. _____ Fuel GAS Capacity _____ ÷ _____

Unit Type KILN Burner Type SINGLE

		(A)		(B)		(C)			
1. Test No.	9-1	9-1		9-1		9-1			
2. Date	8-11-76	8-11-76		8-11-76		8-11-76			
3. Time	905	0955		1122		1410			
4. Load %		83		84		83.5			
5. Process Rate									
6. Flue Diam. or Size, ft									
7. Probe Position									
8. Oxygen (%)	6.6	6.0		6.1		5.2			
9. NOx (hot) read/3% O_2 (ppm)*	1300	1600	1920	1450	1752	987	1124		
10. NO (hot) read/3% O_2 (ppm)*		1500	1800	1375	1661	975	1111		
11. NO_2 (hot) read/3% O_2 (ppm)*		100	120	75	91	12	14		
12. NO (cold) read/3% O_2 (ppm)*	1725	1875	2250	2000	2416	1500	1709		
13. Carbon Dioxide (%)	16.0	16.0		16.0		18.0			
14. Carbon Monoxide (ppm) uncor/cor*	30	25	30	28	34	30	34		
15. Hydrocarbon (ppm) uncor/cor*	20	20	24	10	12	10	11		
16. Sulfur Dioxide (ppm) uncor/cor*	—	0		0.0.0.	—	0	0		
17. Smoke Spot (Bacharach)	—	—		—		—			
18. Atmos. Temp. (°F/°C)		82		88		95			
19. Dew Point Temp. (°F/°C)		73		74		75			
20. Atmos. Pressure (in. Hg)	30.00	29.98		30.00		29.96			
21. Relative Humidity (%)		66		52		40			
22.									
23.									
24.									
25.									
26.									
27.									
28.									
29.		750		810		720			
30.									

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

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PRELIMINARY BASELINE

BASELINE → PARTIC.

BASELINE

"UPSET" CONDITION BRINK

MOBILE LABORATORY DATA Test No._____

Test No. 9-2 Date 8-12-76 Location 9 Engr. HANS

Unit No._____ Fuel GAS Capacity_____

Unit Type KILN Burner Type SINGLE GAS

	(A)		(B)		(C)		(D)		(E)	
1. Test No.	9-2		9-2		9-2		9-2		9-2	
2. Date	8-12-76		8-12-76		8-12-76		8-12-76		8-12-76	
3. Time	0915		0948		1110		1420		1538	
4. Load %	83		83		83		83		83	
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	6.0		5.1		4.5		5.7		5.7	
9. NOx (hot) read/3% O_2 (ppm)*	750	900	900	1019	1200	1309	1825	2147	1287	1514
10. NO (hot) read/3% O_2 (ppm)*	687	824	937	1061	1250	1364	1675	1971	1100	1294
11. NO_2 (hot) read/3% O_2 (ppm)*	63	75	0	0*	0	0	150	176	187	220
12. NO (cold) read/3% O_2 (ppm)*	1075	1290	1275	1443	1775	1936	2200	2588	1925	2265
13. Carbon Dioxide (%)	15.2		15.6		16.0		16.8		17.9	
14. Carbon Monoxide (ppm) uncor/cor*	24	29	26	29	29	32	31	36	24	28
15. Hydrocarbon (ppm) uncor/cor*	20	24	20	23	18	20	18	21	17	20
16. Sulfur Dioxide (ppm) uncor/cor*	0.0.0	—	—	—	—		—		—	
17. Smoke Spot (Bacharach)	—		—		—		—			
18. Atmos. Temp. (°F/°C)	82		86		90		94		92	
19. Dew Point Temp. (°F/°C)	77		78		79		82		80	
20. Atmos. Pressure (in. Hg)	30.00		30.00		30.00		29.95		29.91	
21. Relative Humidity (%)	80		70		62		61		60	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29. COMB. AIR TEMP	740		750		900		915 (AVG.)		930 °F	
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

* WAS CHECKED TWICE

BASELINE LOW KILN TEMP.

LOW O_2

HIGH COMBUSTION AIR TEMP.

HIGH COMBUSTION AIR TEMP.

HIGH COMB. AIR TEMP.

MOBILE LABORATORY DATA

Test No. _____

Test No. 9-2 Date 8-13-76 Location 9 Engr. HANS

Unit No. _____ Fuel GAS Capacity _____

Unit Type KILN Burner Type SINGLE GAS

	(F)		(G)							
1. Test No.	9-2		9-2							
2. Date	8-13-76		8-13-76							
3. Time	1030		1220							
4. Load	83		83							
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position										
8. Oxygen (%)	4.2		5.6							
9. NOx (hot) read/3% O_2 (ppm)*	1100	1179	1125	1315						
10. NO (hot) read/3% O_2 (ppm)*	1050	1125	1082	1241						
11. NO_2 (hot) read/3% O_2 (ppm)*	50	54	63	74						
12. NO (cold) read/3% O_2 (ppm)*	1625	1741	1650	1929						
13. Carbon Dioxide (%)	19.3		17.6							
14. Carbon Monoxide (ppm) uncor/cor*	40	43	24	28						
15. Hydrocarbon (ppm) uncor/cor*	16	17	12	14						
16. Sulfur Dioxide (ppm) uncor/cor*	—	—	—	—						
17. Smoke Spot (Bacharach)	—		—							
18. Atmos. Temp. (°F/°C)	87		92							
19. Dew Point Temp. (°F/°C)	77		79							
20. Atmos. Pressure (in. Hg)	29.89		29.87							
21. Relative Humidity (%)	65		56							
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

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PITOT TEST BRINK

MOBILE LABORATORY DATA

Test No._____

Test No. 9-3 Date 9-29-76 Location 9 Engr. WOOD

Unit No._____ Fuel GAS Capacity_____

Unit Type KILN Burner Type SINGLE

1. Test No.	9-3	9-3	9-3		
2. Date	9-29-76	9-29-76	9-29-76		
3. Time	1620	1625	1630		
4. Load					
5. Process Rate					
6. Flue Diam. or Size, ft					
7. Probe Position	COMP	ESP IN	ESP OUT		
8. Oxygen (%)	6.1	3.5	5.5		
9. NOx (hot) read/3% O_2 (ppm)*	—	830			
10. NO (hot) read/3% O_2 (ppm)*	—	780			
11. NO_2 (hot) read/3% O_2 (ppm)*	—	50			
12. NO (cold) read/3% O_2 (ppm)*	960	1075	770		
13. Carbon Dioxide (%)	16.0	17.6	15.2		
14. Carbon Monoxide (ppm) uncor/cor*	24	28	24		
15. Hydrocarbon (ppm) uncor/cor*	—	N-A —			
16. Sulfur Dioxide (ppm) uncor/cor*	—	—			
17. Smoke Spot (Bacharach)	—	—			
18. Atmos. Temp. (°F/°C)					
19. Dew Point Temp. (°F/°C)					
20. Atmos. Pressure (in. Hg)	29.85	29.85			
21. Relative Humidity (%)					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

T.E. 3 #1

MOBILE LABORATORY DATA

Test No. _____

Test No. 9-4 Date 9-30-76 Location 9 Engr. WOOD

Unit No. _____ Fuel GAS Capacity _____

Unit Type KILN Burner Type SUGGS

1. Test No.	9-4		9-4		9-4							
2. Date	9-30-76		9-30-76		9-30-76							
3. Time	1200		1407		1411							
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	ESP IN		ESP OUT		COMB.							
8. Oxygen (%)	2.3		5.4		4.9							
9. NOx (hot) read/3% O_2 (ppm)*	400	385	—		—							
10. NO (hot) read/3% O_2 (ppm)*	380	361	—		—							
11. NO_2 (hot) read/3% O_2 (ppm)*	20	19	—		—							
12. NO (cold) read/3% O_2 (ppm)*	700	674	390	450	530	615						
13. Carbon Dioxide (%)	19.6		17.2		17.2							
14. Carbon Monoxide (ppm) uncor/cor*	610	587	192	222	44	49						
15. Hydrocarbon (ppm) uncor/cor*	50	48	—		—							
16. Sulfur Dioxide (ppm) uncor/cor*	O.O.C.	—	—		—							
17. Smoke Spot (Bacharach)	—		—		—							
18. Atmos. Temp. (°F/°C)	80		80		80							
19. Dew Point Temp. (°F/°C)	67		67		67							
20. Atmos. Pressure (in. Hg)	29.93		29.93		29.93							
21. Relative Humidity (%)	51		51		51							
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

T.E. #2 →

MOBILE LABORATORY DATA Test No._____

Test No. 9-5 Date 10/4/76 Location 9 Engr. W. CARTER

Unit No._____ Fuel N. G. Capacity_____

Unit Type ROTARY KILN Burner Type_____

HOT LINE IS CONNECTED TO KILN EXIT (ESP IN) - COLD LINE TO ESP OUT (SAMPLE PT.)

1. Test No.	9-5A		9-5B		9-5B		9-5C		9-5C	
2. Date	10-4									
3. Time	1600		1630		1630		1700		1700	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	ESP OUT		ESP IN		ESP OUT		ESP IN		ESP OUT	
8. Oxygen (%)	6.0		6.8		6.5		4.6		6.5	
9. NOx (hot) read/3% O_2 (ppm)*			1200							
10. NO (hot) read/3% O_2 (ppm)*			1100							
11. NO_2 (hot) read/3% O_2 (ppm)*										
12. NO (cold) read/3% O_2 (ppm)*	1150				1325		—	—	1075	1334
13. Carbon Dioxide (%)	16.8		14.4		14.6		17.2		15.6	
14. Carbon Monoxide (ppm) uncor/cor*	0	0	5		3	3	5	5	3	3
15. Hydrocarbon (ppm) uncor/cor*	0	0	0		0		0	0	0	0
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	0		0		0	0	0	0
17. Smoke Spot (Bacharach)	—				—					
18. Atmos. Temp. (°F/°C)	75									
19. Dew Point Temp. (°F/°C)	88									
20. Atmos. Pressure (in. Hg)	29.82									
21. Relative Humidity (%)	56%									
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

NG

DATA

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

START OF T.E. TEST (COLD LINE)

COLD LINE

MOBILE LABORATORY DATA Test No._____

Test No. 9-5 Date 10-4-76 Location 9 Engr._____

Unit No._____ Fuel NG Capacity_____

Unit Type ROTARY KILN Burner Type_____

1. Test No.	9-5D		9-5D									
2. Date	10-4-76		10-4-76									
3. Time	1945		1955									
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft	74" x 64"											
7. Probe Position	ESP IN		ESP OUT									
8. Oxygen (%)	4.9		7.3									
9. NOx (hot) read/3% O_2 (ppm)*	1050	1174	—									
10. NO (hot) read/3% O_2 (ppm)*	1025	1146	—									
11. NO_2 (hot) read/3% O_2 (ppm)*	25	28										
12. NO (cold) read/3% O_2 (ppm)*	1550	1733	1325	1740								
13. Carbon Dioxide (%)	17.5		14.3									
14. Carbon Monoxide (ppm) uncor/cor*	40	45	44	48								
15. Hydrocarbon (ppm) uncor/cor*	50	56	—	—								
16. Sulfur Dioxide (ppm) uncor/cor*	20	22	—	—								
17. Smoke Spot (Bacharach)	—											
18. Atmos. Temp. (°F/°C)	78		—									
19. Dew Point Temp. (°F/°C)	69		—									
20. Atmos. Pressure (in. Hg)	29.70		—									
21. Relative Humidity (%)	64%		—									
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

HOT LINE COLD LINE ESP OUT

Data Sheet 6002-2

MOBILE LABORATORY DATA Test No._____

Test No. 9-6 Date 10-5-76 Location 9 Engr. W. CARTER

Unit No._____ Fuel N. G. Capacity_____

Unit Type ROTARY KILN Burner Type_____

1. Test No.	9-6		9-6 A		9-6 A		9-6 B		9-6 B	
2. Date	10-5-76		———		———		———		→	
3. Time	1105		1255		1300		1430		1430	
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	18" IN		ESP IN		ESP OUT		ESP IN		ESP OUT	
8. Oxygen (%)			3.6		5.8		4.4		6.1	
9. NOx (hot) read/3% O_2 (ppm)*			825	853	—		700	759	—	
10. NO (hot) read/3% O_2 (ppm)*			800	828			625	678	—	
11. NO_2 (hot) read/3% O_2 (ppm)*			25	25						
12. NO (cold) read/3% O_2 (ppm)*			1000	1034	950	1125	1025	1111	850	1027
13. Carbon Dioxide (%)			18.4		17.4				20.0	
14. Carbon Monoxide (ppm) uncor/cor*			56	58	52	67	56	61	48	58
15. Hydrocarbon (ppm) uncor/cor*	005		005		005	—	005	—	005	
16. Sulfur Dioxide (ppm) uncor/cor*			0	0	0	0	0	—	0	
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)	69				77				77	
19. Dew Point Temp. (°F/°C)	66				69				69	
20. Atmos. Pressure (in. Hg)	29.78				29.80				29.80	
21. Relative Humidity (%)	85%				69%				69%	
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

HOT LINE KILN EXIT

COLD LINE PRECIP. OUTLET

MOBILE LABORATORY DATA Test No._____

Test No. 9-6 Date 10/5/76 Location 9 Engr. W. CARTER

Unit No._____ Fuel N. G. Capacity_____

Unit Type ROTARY KILN Burner Type_____

1. Test No.	9-6 C		9-6 C		9-6 D		9-6 D					
2. Date	10-5-76		10-5-76		10/5/76		10/5/76					
3. Time	1615		1610		1720		1725					
4. Load												
5. Process Rate												
6. Flue Diam. or Size, ft												
7. Probe Position	ESP IN		ESP OUT		ESP IN		ESP OUT					
8. Oxygen (%)	4.9		7.4		5.0		6.6					
9. NOx (hot) read/3% O_2 (ppm)*	1050	1174	—		875	984	—					
10. NO (hot) read/3% O_2 (ppm)*	925	1034	—		850	956	—					
11. NO_2 (hot) read/3% O_2 (ppm)*												
12. NO (cold) read/3% O_2 (ppm)*	1500	1677	1050	1390	1200	1350	850	1062				
13. Carbon Dioxide (%)	17.2		16.0		18.8		16.8					
14. Carbon Monoxide (ppm) uncor/cor*	36	40	32	42	48	54	40	50				
15. Hydrocarbon (ppm) uncor/cor*	80	89	15	20	40	45	35	44				
16. Sulfur Dioxide (ppm) uncor/cor*	0	0	0	0	0	0	0	0				
17. Smoke Spot (Bacharach)												
18. Atmos. Temp. (°F/°C)							76					
19. Dew Point Temp. (°F/°C)							67					
20. Atmos. Pressure (in. Hg)							29.80					
21. Relative Humidity (%)							63%					
22.												
23.												
24.												
25.												
26.												
27.												
28.												
29.												
30.												

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

MOBILE LABORATORY DATA

Test No. _____

Test No. 9-6 Date 10/5/76 Location 9 Engr. W. CA[illegible]

Unit No. _____ Fuel N.G. Capacity _____

Unit Type ROTARY KILN Burner Type _____

1. Test No.	9-6 E		9-6 E							
2. Date	10/5/76		10/5/76							
3. Time										
4. Load										
5. Process Rate										
6. Flue Diam. or Size, ft										
7. Probe Position	ESP IN		ESP OUT							
8. Oxygen (%)	4.0		6.0							
9. NOx (hot) read/3% O_2 (ppm)*	750	794	—							
10. NO (hot) read/3% O_2 (ppm)*	720	741	—							
11. NO_2 (hot) read/3% O_2 (ppm)*										
12. NO (cold) read/3% O_2 (ppm)*	1025	1085	900	1050						
13. Carbon Dioxide (%)	17.6		16.8							
14. Carbon Monoxide (ppm) uncor/cor*	48	51	96	115						
15. Hydrocarbon (ppm) uncor/cor*	30	32	—	—						
16. Sulfur Dioxide (ppm) uncor/cor*	20	21	—	—						
17. Smoke Spot (Bacharach)										
18. Atmos. Temp. (°F/°C)										
19. Dew Point Temp. (°F/°C)			76							
20. Atmos. Pressure (in. Hg)			69							
21. Relative Humidity (%)			29.80							
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

*Correction to 3% O_2 should not be performed if the value is measured on a wet basis.

Data Sheet 6002-2

OPERATING DATA

LOCATION 9

Test No. 9-1 (A) Time: 10:00 DATE: AUG. 11, 1976

Kiln Speed, %/RPH	95.5 / 113
Kiln Feeder Speed, %/RPH	83 / 350
Temperatures	
Kiln Temp. °F	2900
Kiln Feed end Temp. °F	330
Kiln Gas Temp., Chains °F	1475
Comb. Air Temp. °F	750 ✓
Kiln ID intake temp. °F	275
Gas Flow %	75
Cooler Speed %/RPM	54 / ~13
ID Damper position % open	58
Pressures	
ID Draft "H_2O	-6.5
Grate Press. "H_2O	6.4
Hood Press. "H_2O	-.06
Fuel Gas Supply Press, PSIG	> 60
Burner Gas Press, PSIG	26
Vent. Damper pos. % open	28
Control Room O_2	2.4

BASELINE, PARTIC. TEST

OPERATING DATA

LOCATION 9

Test No. 9-1 (B) Time: 11:25 DATE: AUG. 11, 1976

Kiln Speed, %/RPH	96.5/114
Kiln Feeder Speed, %/RPH	54/331
Temperatures	
Kiln Temp. °F	2900
Kiln Feed end Temp. °F	325
Kiln Gas Temp., Chains °F	1140
Comb. Air Temp. °F	810
Kiln ID intake temp. °F	275
Gas Flow %	76
Cooler Speed %/RPM	55/1:1
ID Damper position % open	56
Pressures	
ID Draft "H_2O	-6.3
Grate Press. "H_2O	6.5
Hood Press. "H_2O	-.06
Fuel Gas Supply Press,PSIG	65.2
Burner Gas Press, PSIG	26
Vent. Damper pos. % open	26
Control Room O_2	2.0

BASELINE

OPERATING DATA

LOCATION 9

Test No. 9-1 (C) Time: 2:30 PM DATE: AUG. 11, 1976

Kiln Speed, %/RPH	96.5/110
Kiln Feeder Speed, %/RPH	83.5/351
Temperatures	
Kiln Temp. °F	2450
Kiln Feed end Temp. °F	1320
Kiln Gas Temp., Chains °F	1440
Comb. Air Temp. °F	720
Kiln ID intake temp. °F	275
Gas Flow %	80
Cooler Speed %/RPM	54/13.5
ID Damper position % open	56%
Pressures	
ID Draft "H_2O	-6.3
Grate Press. "H_2O	6.4
Hood Press. "H_2O	-0.06
Fuel Gas Supply Press, PSIG	64.2
Burner Gas Press, PSIG	28
Vent. Damper pos. % open	30
Control Room O_2	1.8

BASELINE, BRINK

OPERATING DATA

LOCATION 9

Test No. 9-2 (A) Time: 9:15 DATE: AUG. 12, 1976

Kiln Speed, %/RPH	94.5/113
Kiln Feeder Speed, %/RPH	83/350
Temperatures	
Kiln Temp. °F	2200
Kiln Feed end Temp. °F	330
Kiln Gas Temp., Chains °F	1460
Comb. Air Temp. °F	740
Kiln ID intake temp. °F	270
Gas Flow %	78
Cooler Speed %/RPM	53/12.5
ID Damper position % open	56
Pressures	
ID Draft "H_2O	-6.4
Grate Press. "H_2O	6.2
Hood Press. "H_2O	-.06
Fuel Gas Supply Press,PSIG	63
Burner Gas Press, PSIG	26
Vent. Damper pos. % open	36
Control Room O_2	1.8 ÷ 2.2

BASELINE (LOW KILN TEMP.)

OPERATING DATA

LOCATION 9

Test No. 9-2 (B) Time: 9:50 DATE: AUG. 12, 1976

Kiln Speed, %/RPH	94.5/113
Kiln Feeder Speed, %/RPH	83/350
Temperatures	
Kiln Temp. °F	2450 ÷ 2500
Kiln Feed end Temp. °F	325
Kiln Gas Temp., Chains °F	1450
Comb. Air Temp. °F	750
Kiln ID intake temp. °F	270
Gas Flow %	78
Cooler Speed %/RPM	58/13.7
ID Damper position % open	53
Pressures	
ID Draft "H_2O	6.3
Grate Press. "H_2O	6.8
Hood Press. "H_2O	-.06
Fuel Gas Supply Press, PSIG	65.6
Burner Gas Press, PSIG	27.0
Vent. Damper pos. % open	28
Control Room O_2	.3 ÷ 1.2 (Ave. ~.8)

LOW O_2 TEST

OPERATING DATA

LOCATION 9

Test No. 9-2 (C) Time: 11:15 DATE: AUG. 12, 1976

Kiln Speed, %/RPH	95.5/113
Kiln Feeder Speed, %/RPH	83/351
Temperatures	
Kiln Temp. °F	2750
Kiln Feed end Temp. °F	310
Kiln Gas Temp., Chains °F	1360
Comb. Air Temp. °F	900
Kiln ID intake temp. °F	260
Gas Flow %	78
Cooler Speed %/RPM	55/13.3
ID Damper position % open	53
Pressures	
ID Draft "H_2O	-6.3
Grate Press. "H_2O	6.6
Hood Press. "H_2O	-.06
Fuel Gas Supply Press, PSIG	64.5
Burner Gas Press, PSIG	27.5
Vent. Damper pos. % open	24
Control Room O_2	.1 ÷ .9

HIGH COMB AIR TEMP. LOW O_2

OPERATING DATA

LOCATION 9

Test No. 9-2 (D) Time: 14:30 DATE: AUG. 12, 1976

Kiln Speed, %/RPH	95/113
Kiln Feeder Speed, %/RPH	83/349
Temperatures	
Kiln Temp. °F	2900
Kiln Feed end Temp. °F	325
Kiln Gas Temp., Chains °F	1470
Comb. Air Temp. °F	900 ÷ 930
Kiln ID intake temp. °F	260
Gas Flow %	74
Cooler Speed %/RPM	38/8.2
ID Damper position % open	53
Pressures	
ID Draft "H_2O	-6.2
Grate Press. "H_2O	6.0
Hood Press. "H_2O	-.06
Fuel Gas Supply Press, PSIG	67.5
Burner Gas Press, PSIG	26.5
Vent. Damper pos. % open	38
Control Room O_2	1.6 ÷ 2.2

HIGH COMB. AIR TEMP. NORM. O_2

OPERATING DATA

LOCATION 9

Test No. 9-2 (E) Time: 15:30 DATE: AUG. 12, 1976

Kiln Speed, %/RPH	96/112
Kiln Feeder Speed, %/RPH	83/350
Temperatures	
Kiln Temp. °F	2840
Kiln Feed end Temp. °F	320
Kiln Gas Temp., Chains °F	1400
Comb. Air Temp. °F	930
Kiln ID intake temp. °F	265
Gas Flow %	72
Cooler Speed %/RPM	60/13.5
ID Damper position % open	53
Pressures	
ID Draft "H_2O	-6.4
Grate Press. "H_2O	5.9
Hood Press. "H_2O	-.06
Fuel Gas Supply Press,PSIG	66
Burner Gas Press, PSIG	26
Vent. Damper pos. % open	48
Control Room O_2	1.8

HIGH COMB. AIR TEMP. NORM. O_2

OPERATING DATA

LOCATION 9

Test No. 9-2 (F) Time: 10:35 DATE: AUG. 13, 1976

Kiln Speed, %/RPH	96.5/112
Kiln Feeder Speed, %/RPH	83/351
Temperatures	
Kiln Temp. °F	2450
Kiln Feed end Temp. °F	310
Kiln Gas Temp., Chains °F	1350
Comb. Air Temp. °F	900 ÷ 1000 (SWING)
Kiln ID intake temp. °F	265
Gas Flow %	76
Cooler Speed %/RPM	60 ÷ 70/~15
ID Damper position % open	52
Pressures	
ID Draft "H_2O	-.64
Grate Press. "H_2O	6.5
Hood Press. "H_2O	-.06
Fuel Gas Supply Press, PSIG	65
Burner Gas Press, PSIG	27
Vent. Damper pos. % open	30
Control Room O_2	.1 ÷ 1.0

PARTIC. HIGH COMB. AIR TEMP. LOW O_2

OPERATING DATA
LOCATION 9

Test No. 9-2 (G) Time: 11:50 DATE: AUG. 13, 1976

Kiln Speed, %/RPH	96.5/114
Kiln Feeder Speed, %/RPH	83/351
Temperatures	
Kiln Temp. °F	2650
Kiln Feed end Temp. °F	310
Kiln Gas Temp., Chains °F	1350
Comb. Air Temp. °F	800 ÷ 840
Kiln ID intake temp. °F	265
Gas Flow %	74
Cooler Speed %/RPM	63/~14
ID Damper position % open	51
Pressures	
ID Draft "H_2O	-6.3
Grate Press. "H_2O	6.4
Hood Press. "H_2O	-.06
Fuel Gas Supply Press, PSIG	65
Burner Gas Press, PSIG	26
Vent. Damper pos. % open	34
Control Room O_2	.2 ÷ 1.0

BRINK, HIGH COMB. AIR TEMP., LOW O_2.

OPERATING DATA

LOCATION 9

Test No. 9-3 Time: 1609 DATE: 9-29-76

Kiln Speed, %/RPH	95/112
Kiln Feeder Speed, %/RPH	78/330
Temperatures	
Kiln Temp. °F	2820
Kiln Feed end Temp. °F	295
Kiln Gas Temp., Chains °F	1400
Comb. Air Temp. °F	1050
Kiln ID intake temp. °F	270
Gas Flow %	37
Cooler Speed %/RPM	36/—
ID Damper position % open	60
Pressures	
ID Draft "H_2O	6.3
Grate Press. "H_2O	5.4
Hood Press. "H_2O	5.0
Fuel Gas Supply Press, PSIG	26
Burner Gas Press, PSIG	26
Vent. Damper pos. % open	45
Control Room O_2	2%

GAS METER
Red = 25
Black = 79
} 209,557 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-3 Time: 1800 DATE: 9-29-76

Kiln Speed, %/RPH	96/112
Kiln Feeder Speed, %/RPH	77/1329
Temperatures	
Kiln Temp. °F	2960
Kiln Feed end Temp. °F	310
Kiln Gas Temp., Chains °F	1330
Comb. Air Temp. °F	1095
Kiln ID intake temp. °F	265
Gas Flow %	35
Cooler Speed %/RPM	30/—
ID Damper position % open	45
Pressures	
ID Draft "H_2O	6.3
Grate Press. "H_2O	5.6
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press,PSIG	65.6
Burner Gas Press, PSIG	24.5
Vent. Damper pos. % open	53
Control Room O_2	1.5

GAS METER

Red = 23
Black = 79 } 201,000 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-4 Time: 1347 DATE: 9-30-76

Kiln Speed, %/RPH	97/114
Kiln Feeder Speed, %/RPH	76/321
Temperatures	
Kiln Temp. °F	2570
Kiln Feed end Temp. °F	310
Kiln Gas Temp., Chains °F	640
Comb. Air Temp. °F	960
Kiln ID intake temp. °F	265
Gas Flow %	37
Cooler Speed %/RPM	68/—
ID Damper position % open	26
Pressures	
ID Draft "H_2O	6
Grate Press. "H_2O	7
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press,PSIG	26
Burner Gas Press, PSIG	26
Vent. Damper pos. % open	26
Control Room O_2	1.0

GAS METER @ 1400 hrs

Red 28.2
Black 78.2 } 221,436 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-4 Time: 1537 DATE: 9-30-76

Kiln Speed, %/RPH	95/—
Kiln Feeder Speed, %/RPH	75/—
Temperatures	
Kiln Temp. °F	2980
Kiln Feed end Temp. °F	300
Kiln Gas Temp., Chains °F	650
Comb. Air Temp. °F	1150
Kiln ID intake temp. °F	310
Gas Flow %	35
Cooler Speed %/RPM	50/—
ID Damper position % open	17
Pressures	
ID Draft "H_2O	-6.4
Grate Press. "H_2O	6.3
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press,PSIG	25
Burner Gas Press, PSIG	25
Vent. Damper pos. % open	42
Control Room O_2	1.0

GAS METER

Red 24
Black 90 } @ 1547 hrs = 206,619 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-5 Time: 1600 DATE: 10-4-76

Kiln Speed, %/RPH	-/115
Kiln Feeder Speed, %/RPH	-/323
Temperatures	
Kiln Temp. °F	2450
Kiln Feed end Temp. °F	330
Kiln Gas Temp., Chains °F	1340
Comb. Air Temp. °F	980
Kiln ID intake temp. °F	265
Gas Flow %	35
Cooler Speed %/RPM	28/13
ID Damper position % open	39
Pressures	
ID Draft "H_2O	4.2
Grate Press. "H_2O	6
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press,PSIG	65
Burner Gas Press, PSIG	23
Vent. Damper pos. % open	26
Control Room O_2	2

GAS METER

Red = 23.5

Black = 78.0 } @1604 ; 201,883 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-5 Time: 1711 DATE: 10-4-76

Kiln Speed, %/RPH	97/114
Kiln Feeder Speed, %/RPH	75/320
Temperatures	
Kiln Temp. °F	2850
Kiln Feed end Temp. °F	310
Kiln Gas Temp., Chains °F	1380
Comb. Air Temp. °F	980
Kiln ID intake temp. °F	270
Gas Flow %	33
Cooler Speed %/RPM	28/13
ID Damper position % open	39
Pressures	
ID Draft "H_2O	4.3
Grate Press. "H_2O	6
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press, PSIG	65
Burner Gas Press, PSIG	23
Vent. Damper pos. % open	28
Control Room O_2	1.1

GAS METER

Red 21.0

Black 19.0 @ 1722 = 192,063 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-5 Time: 1900 DATE: 10-4-76

Kiln Speed, %/RPH	97/115
Kiln Feeder Speed, %/RPH	75/321
Temperatures	
Kiln Temp. °F	2870
Kiln Feed end Temp. °F	305
Kiln Gas Temp., Chains °F	1380
Comb. Air Temp. °F	1018
Kiln ID intake temp. °F	260
Gas Flow %	34
Cooler Speed %/RPM	55/13.5
ID Damper position % open	39
Pressures	
ID Draft "H_2O	4.3
Grate Press. "H_2O	6.2
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press,PSIG	66
Burner Gas Press, PSIG	24
Vent. Damper pos. % open	35
Control Room O_2	0.5

GAS METER

Red 22

Black 79 @ 1902 hrs gas flow = 196,582 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-5 Time: 2009 DATE: 10-4-76

Kiln Speed, %/RPH	97/112
Kiln Feeder Speed, %/RPH	75/321
Temperatures	
Kiln Temp. °F	2815
Kiln Feed end Temp. °F	310
Kiln Gas Temp., Chains °F	1400
Comb. Air Temp. °F	970
Kiln ID intake Temp. °F	260
Gas Flow %	33
Cooler Speed %/RPM	55/12
ID Damper position % open	41
Pressures	
ID Draft "H_2O	4.5
Grate Press. "H_2O	6.1
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press, PSIG	66
Burner Gas Press, PSIG	23
Vent. Damper pos. % open	28
Control Room O_2	1.8

GAS METER

Red 20
Black 80 @ 2008 hrs 188,616 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-6 Time: 1200 DATE: 10-5-76

Kiln Speed, %/RPH	96-97 / 113
Kiln Feeder Speed, %/RPH	75 / 319
Temperatures	
Kiln Temp. °F	2840
Kiln Feed end Temp. °F	292
Kiln Gas Temp., Chains °F	1295
Comb. Air Temp. °F	1020
Kiln ID intake temp. °F	250
Gas Flow %	35
Cooler Speed %/RPM	58 / 13.5
ID Damper position % open	38
Pressures	
ID Draft "H_2O	4.2
Grate Press. "H_2O	6.3
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press, PSIG	65
Burner Gas Press, PSIG	24
Vent. Damp[illegible] pos. % open	32
Control Room O_2	0.9

GAS METER

Red = 23

Black = 78 @ 1208. Gas flow = 199,724 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-6 Time: 1416 DATE: 10-5-76

Kiln Speed, %/RPH	97/108
Kiln Feeder Speed, %/RPH	75/319
Temperatures	
Kiln Temp. °F	2500
Kiln Feed end Temp. °F	300
Kiln Gas Temp., Chains °F	1260
Comb. Air Temp. °F	810
Kiln ID intake temp. °F	250
Gas Flow %	36
Cooler Speed %/RPM	55/12
ID Damper position % open	40
Pressures	
ID Draft "H_2O	4.5
Grate Press. "H_2O	6.0
Hood Press. "H_2O	0.04
Fuel Gas Supply Press,PSIG	64
Burner Gas Press, PSIG	25
Vent. Damper pos. % open	34
Control Room O_2	0.9

GAS METER

Red = 25

Black = 77 @ 1424 ⇒ 206,888 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-6 Time: 1546 DATE: 10-5-76

Kiln Speed, %/RPH	96/113
Kiln Feeder Speed, %/RPH	75/319
Temperatures	
Kiln Temp. °F	2880
Kiln Feed end Temp. °F	310
Kiln Gas Temp., Chains °F	1350
Comb. Air Temp. °F	960
Kiln ID intake temp. °F	260
Gas Flow %	33.5
Cooler Speed %/RPM	37/8.5
ID Damper position % open	40
Pressures	
ID Draft "H_2O	4.5
Grate Press. "H_2O	5.5
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press, PSIG	65
Burner Gas Press, PSIG	23
Vent. Damper pos. % open	36
Control Room O_2	2

GAS METER
Red = 21.5
Black = 78 @ 1554 hrs ⇒ 193,102 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-6 Time: 1710 DATE: 10-5-76

Kiln Speed, %/RPH	96/112
Kiln Feeder Speed, %/RPH	75/319
Temperatures	
Kiln Temp. °F	2520
Kiln Feed end Temp. °F	300
Kiln Gas Temp., Chains °F	1300
Comb. Air Temp. °F	920
Kiln ID intake temp. °F	250
Gas Flow %	35
Cooler Speed %/RPM	60/14
ID Damper position % open	40
Pressures	
ID Draft "H_2O	4.5
Grate Press. "H_2O	6.2
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press, PSIG	65
Burner Gas Press, PSIG	24
Vent. Damper pos. % open	34
Control Room O_2	0.7

GAS METER
Red = 23
Black = 78 @ 1717 HRS ⇒ 199,724 SCFH

OPERATING DATA

LOCATION 9

Test No. 9-6 Time: 1749 DATE: 10-5-76

Kiln Speed, %/RPH	97/113
Kiln Feeder Speed, %/RPH	75/319
Temperatures	
Kiln Temp. °F	2320
Kiln Feed end Temp. °F	300
Kiln Gas Temp., Chains °F	1270
Comb. Air Temp. °F	930
Kiln ID intake temp. °F	250
Gas Flow %	36
Cooler Speed %/RPM	55/13
ID Damper position % open	40
Pressures	
ID Draft "H_2O	4.5
Grate Press. "H_2O	6
Hood Press. "H_2O	-0.04
Fuel Gas Supply Press, PSIG	65
Burner Gas Press, PSIG	25
Vent. Damper pos. % open	39
Control Room O_2	0.2

GAS METER
Red = 24.5
Black = 78 @ 1757 HRS

LOCATION 9

FUEL GAS CHROMATOGRAPHIC ANALYSIS

CONSTITUENT	MOL %	GAL/MCF
HELIUM	0.01	*****
CARBON DIOXIDE	1.00	*****
OXYGEN	0.0	*****
NITROGEN	0.78	*****
METHANE	96.44	*****
ETHANE	1.32	0.35
PROPANE	0.27	0.07
ISOBUTANE	0.03	0.01
N-BUTANE	0.04	0.01
ISOPENTANE	0.01	0.0
N-PENTANE	0.01	0.0
HEXANES+	0.09	0.04
TOTALS	100.00	0.48

TOTAL GAL/MCF, W/O ETHANE = 0.13
CALCULATED SPECIFIC GRAVITY = 0.580
CALCULATED INTERCHANGE FAC. = 1312.
HYDROGEN SULFIDE = ND

CALORIMETER BTU = 999.
CALCULATED BTU = 999.

LOCATION 9

FUEL GAS CHROMATOGRAPHIC ANALYSIS

CHROMATOGRAPH ANALYSIS:	MOL %	GPM @14.65 PSIA
CARBON DIOXIDE	0.10	
NITROGEN	0.88	
METHANE	95.64	
ETHANE	2.04	
PROPANE	0.70	0.192
ISO-BUTANE	0.15	0.049
N-BUTANE	0.21	0.066
ISO-PENTANE	0.06	0.022
N-PENTANE	0.06	0.022
HEXANES PLUS	0.16	0.068
	100.00	0.419

SPECIFIC GRAVITY @ 60° F. (AIR = 1) 0.5891

B.T.U./CU. FT. @ 14.696 PSIA AND 60°F.:
DRY BASIS 1044
WET BASIS 1026

PARTICULATE EMISSION CALCULATIONS

Method 5 — Test No. 9-1

Test No. 9-1 Date 8-11-76 Location Gulf Coast Cement Engr. B.

Unit No. 1 Fuel N. G. Load 83%

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.99 in. Hg

Tot. Liquid Collected, V_{lc} 130 ml Total Particulate, M_n 6684.6 m gm

Velocity Head, ΔP .09 iwg Stack Temp., Ts 760 °R Stack Area, As 45 ft^2

Sample Volume, Vm 7.93 ft^3 Stack Press., Psg -6.4 iwg Excess O_2, XO_2% 6.0 %

Orifice Press. Diff., H .62 iwg Stack Gas Sp. Gravity, Gs 1.03 n.d.

Sample Time, θ 15 min Nozzle Diameter, Dn .375 in.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	7.955	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	6.162	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.4365	N.D.
4. Concentration a.	$C = 0.0154\ Mn/Vm_{std}$	12.941	grains/DSCF
b.	$C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.853×10^{-3}	lb/DSCF
c.	C = Eq. 4b x 16.018 x 10^3	29.681	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	401.46	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	1199.26	ft/min
7. Stack Gas Flow Rate @ 70°F a.	Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	37122	WSCF/min
b.	Qsd = Eq. 7a x (1. - Eq. 3)	20918	DSCF/min/duct
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2.326×10^3	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	140.27	N.D.
10. Emission per duct a.	E = Eq. 4b x Fe x Eq. 9	25.54 ~~22.747~~	lb/MMBtu
b.	E = Eq. 4c x Fm x Eq. 9 x 1000	10983. ~~9767.2~~	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	148.72	%

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

Qsw + CO2 98.28

Note: starting with test 9-1 a bigger brush for probe cleaning was used. It was felt that the older smaller brush did not completly clean probe at acetone wash.

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS

Modified Meth. 5

Test No. 9-1

Test No. 9-1 Date 2-11-76 Location Gulf Coast Conv. Engr. K.

Unit No. 1 Fuel N.G. Load 83%

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.99 in. Hg

Tot. Liquid Collected, V_{lc} 130 ml Total Particulate, M_n 6710.3 m gm

Velocity Head, ΔP .09 iwg Stack Temp., Ts 760 °R Stack Area, As 45 ft^2

Sample Volume, Vm 7.93 ft^3 Stack Press., Psg -6.4 iwg Excess O_2, XO_2% 6.0 %

Orifice Press. Diff., H .62 iwg Stack Gas Sp. Gravity, Gs 1.03 n.d.

Sample Time, θ 15 min Nozzle Diameter, Dn .375 in.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	7.955 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	6.162 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.4365 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	12.991 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.860×10^{-3} lb/DSCF
	c. C = Eq. 4b x 16.018×10^3	29.795 grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	401.46 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	1199.26 ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = \text{Eq. 6} \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	37122 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	20918 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2.335×10^3 lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	140.27 N.D.
10. Emission per fuel	a. E = Eq. 4b x Fe x Eq. 9	25.64 ~~22.80~~ lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	11028 ~~9809.8~~ ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	148.72 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	~~87.4~~ 98.28	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

gas + CO2

98.28

98.28

86.20 - N.G.

+ 12.14 - fuel CO2

98.35

Data Sheet 6002-4

CASCADE IMPACTOR (BRINK)

PARTICULATE EMISSION CALCULATIONS

Test No. 9-1

Test No. 9-1 Data 8/11/76 Location GULF COAST Engr. SCH 9/22/76

Unit No. 1 Fuel NG Load 84%

Pitot Factor, Fs ? Barometric Pressure, P_{bar} 29.96 in. Hg

Tot. Liquid Collected, V_{lc} ? ml Total Particulate, M_n 573.7 m gm

Velocity Head, ΔP ? iwg Stack Temp., Ts 770 °R Stack Area, As 45 ft^2

Sample Volume, Vm .70 ft^3 Stack Press., Psg −6.4 iwg Excess O_2, $\%O_2$ ~6.0 %

Orifice Press. Diff., H ? iwg Stack Gas Sp. Gravity, Gs ? n.d.

Sample Time, θ 8 min Nozzle Diameter, Dn 4 mm = .157in

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	.70096	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	~.55	SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	~.4365	N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	12.621	grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	.00181	lb/DSCF
	c. C = Eq. 4b x 16.018×10^3 (29.795 Method 5)	28.947	grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	401.06	in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs\ \sqrt{\Delta P Ts}\ \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ (pitot)	11988	ft/min 19.98 f/s
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	36603	WSCF/min
	b. Qsd = Eq. 7a x (1. − Eq. 3)	20649	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2242	lb/hr
9. $\%O_2$ factor	$\%O_2 f = 2090/(20.9 - \%O_2)$	140.27	N.D.
10. Emission	a. E = Eq. 4b x Fe x Eq. 9	22.19	lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	9525.7	ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	142.04 % (79.5) at Vmstd only	

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	87.4	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

60% < 3μ

= 9525.7 * .6

= 5715 ng/J

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS

Test No. 9-2 (Mch. 6)

Test No. 9-2 Date 8-13-76 Location Gulf Coast Gen. Engr. Ko

Unit No. 1 Fuel N. G. Load 83%

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.89 in. Hg

Tot. Liquid Collected, V_{lc} 126.5 ml Total Particulate, M_n 5735 m gm

Velocity Head, ΔP .12 iwg Stack Temp., Ts 750 °R Stack Area, As 45 ft^2

Sample Volume, Vm 7.42 ft^3 Stack Press., Psg -6.4 iwg Excess O_2, XO_2% 4.2 %

Orifice Press. Diff., H .54 iwg Stack Gas Sp. Gravity, Gs 1.03 n.d.

Sample Time, θ 15 min Nozzle Diameter, Dn .375 in.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$	7.447 SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	5.996 SCF
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.446 N.D.
4. Concentration	a. $C = 0.0154\ Mn/Vm_{std}$	11.86 grains/DSCF
	b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.698×10^{-3} lb/DSCF
	c. C = Eq. 4b x 16.018 x 10^3	27.199 grams/DSCM
5. Abs. Stack Press.	$Ps = P_{bar} \times 13.6 + Psg$	400.10 in. w abs.
6. Stack Gas Speed	$Vs = 174\ Fs \sqrt{\Delta P Ts} \sqrt{\frac{407}{Ps}} \times \frac{1.00}{Gs}$	1377.98 ft/min
7. Stack Gas Flow Rate @ 70°F	a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$	43076.9 WSCF/min
	b. Qsd = Eq. 7a x (1. - Eq. 3)	23864.6 DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	2.43×10^3 lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	125.15 N.D.
10. Emission per Btu	a. E = Eq. 4b x Fe x Eq. 9	20.89 ~~10.573~~ lb/MMBtu
	b. E = Eq. 4c x Fm x Eq. 9 x 1000	8979.5 ~~7985.68~~ ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	122.0 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	~~97.4~~ 98.28	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

Data Sheet 6002-4

PARTICULATE EMISSION CALCULATIONS
Modif. Meth. 5

Test No. _____

Test No. 9-2 Date 8-13-76 Location Gulf Coast C. Engr. K.

Unit No. 1 Fuel N.G. Load 83%

Pitot Factor, Fs .84 Barometric Pressure, P_{bar} 29.89 in. Hg

Tot. Liquid Collected, V_{lc} 126.5 ml Total Particulate, M_n 5748 m gm

Velocity Head, ΔP .12 iwg Stack Temp., Ts 750 °R Stack Area, As 45 ft^2

Sample Volume, Vm 7.42 ft^3 Stack Press., Psg -6.4 iwg Excess O_2, XO_2% 4.2 %

Orifice Press. Diff., H .54 iwg Stack Gas Sp. Gravity, Gs 1.03 n.d.

Sample Time, θ 15 min Nozzle Diameter, Dn .375 in.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$ — 7.447 SCF
2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ — 5.996 SCF
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) — .446 N.D.
4. Concentration a. $C = 0.0154\ Mn/Vm_{std}$ — 11.89 grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ — 1.70×10^{-3} lb/DSCF
   c. C = Eq. 4b x 16.018 x 10^3 — 27.26 grams/DSCM
5. Abs. Stack Press. $Ps = P_{bar} \times 13.6 + Psg$ — 400.1 in. w abs.
6. Stack Gas Speed $Vs = 174\ Fs \sqrt{\Delta PTs} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ — 1377.98 ft/min
7. Stack Gas Flow Rate @ 70°F a. $Qsw = Eq.\ 6 \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$ — 43076.9 WSCF/min
   b. Qsd = Eq. 7a x (1. - Eq. 3) — 23864.6 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 — 2.43×10^3 lb/hr
9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ — 125.15 N.D.
10. Emission a. E = Eq. 4b x Fe x Eq. 9 — 20.93 ~~18.615~~ lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 — 9000.8 8003.78 ng/joule
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ — 122.0 %

	Oil	Gas	Coal
Fe SC Feet/10^4 Btu	92.2	~~87.4~~	98.2
Fm SC Meters/10^4 joules	0.002475	0.002346	0.002636

98.28

Data Sheet 6002-4

PARTICULATE CALCULATION SHEET

Test No. 9-1 (Inlet, Outlet) Location GULF CEMENT, HOUSTON, TEX.
Box No. _____ Test Date 8/11/76
Test Description: Partic. Baseline

Dry Gas Meter Vol (ft3)
Final 1339.85
Initial 1331.92
Total 7.93

130.0

Impinger Water Vol (ml)

	1	2	3	Total	
Final	196	128	0	324	674.0
Initial	100	100	0	200	668.7
Δ Vol	96	28	0	124	6.0

	670 ml	520 ml	375 ml			Filter No.	Blank No.
Beaker No.	1	2	3		4	3	4
Date Weighed	8/11/76	→	→	→	→	7/10/76	7/10/76
Tare Wt. 1	100.0938	101.6243	101.4079		99.2628	.8142	.8066
2	100.0939	101.6243	101.4079		99.2630	.8141	.8065
3							
4							
5							
6							
Avg	100.0937	101.6243	101.4079		99.2629	.8142	.8066
Bottle No.	1 & 2	3	4				
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	~~Cyclone (Acetone)~~	Flask (Dry)		
Rinse (ml)	200 120 50 280 100	200 100 280	200 175				
Date Weighed or 250 Bake)	8/13/76	8/13/76	8/13/76		8/12/76	8/12/76	8/12/76
Final Wt. 250 1	100.0995	102.2594	101.4305		103.9105	2.2162	.8066
2	100.0996	102.2596	101.4305		103.9107	2.2165	.8066
3						2.2166	
4							
5							
6							
Avg	100.0996	102.2595	101.4305		103.9106	2.2164	.8066
Residue Wt Final 250 Tare	.0057	.6352	.0226		4.6477	1.4022	0
Date Weighed or 650 Bake)							
Final Wt. 650 1							
2							
3							
4							
5							
6							
Avg							
Residue Wt. Final 650 Tare)							

Comments: ACETONE BLANK AVG. for 200 ml 100.9351 TARE, 100.9349 FINAL, − .0002

H_2O BLANK AVG. 100.1834 TARE, 100.1839 FINAL, + .0005

128
196
324

Method 5	Mod. Meth. 5
1.4022	6.6846
4.6477	.0226
.6352	.0057
−.0005	−.0026
6.6846	6.7103

PARTICULATE CALCULATION SHEET

Test No. 9-2 (Inlet, Outlet)
Box No. ____
Test Description: ____

Location GULF COAST CEMENT, HOUSTON, TEX.
Test Date 8/13/76

Dry Gas Meter Vol (ft3)
Final 1349.66
Initial 1342.24
Total 7.42

126.5

Impinger Water Vol (ml)	1	2	3	Total	
Final	244	77	1	322	678.7
Initial	100	100	0	200	674.2
Δ Vol	144	-23	1	122	4.5

	(660 ml)	(730 ml)	(375 ml)			Filter No.	Blank No.
Beaker No.	5	6	7		8	4	5
Date Weighed	8/11/76	—	—				▶
Tare Wt. 1	98.9348	100.4818	104.0046		99.3347	.8066	.8419
2	98.9351	100.4818	104.0050		99.3350	.8066	.8422
3							
4							
5							
6							
Avg	98.9350	100.4818	104.0048		99.3349	.8066	.8421
Bottle No.	5 & 6	7 & 9	8				
Content	Impinger (Water)	Probe (Acetone)	Probe (Water)	~~Acetone Blank~~	Flask (Dry)		
Rinse (ml)	200 200 110 40	200 150 150 70 100	200 100 75				
Date Weighed or 250 Bake)	8/16/76	8/16/76	—				▶
Final Wt. 250 1	98.9373	101.6449	104.0181		102.6640	2.0496	.8424
2	98.9374	101.6451	104.0182		102.6642	2.0499	.8425
3							
4							
5							
6							
Avg	98.9374	101.6450	104.0182		102.6641	2.0497	.8424
Residue Wt Final 250 Tare)	.0024	1.1632	.0134		3.3292	1.2431	.0003
Date Weighed or 650 Bake)							
Final Wt. 650 1							
2							
3							
4							
5							
6							
Avg							
Residue Wt. Final 650 Tare)							

Comments:
350
350
350

H₂O Blank +.0005 /200 ml
Acetone Blank -.0002 (wt o)

Meth. 5	Meth. 5
1.2428	5.7352
3.3292	.0134
1.1632	.0024
5.7352	-.0026
	5.7484

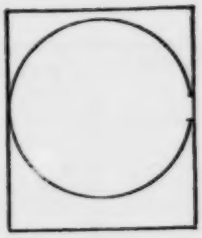
K V B, INC.

STACK DATA

Test No. 9-1
Engr. H. BUFNING

Date 8/11/76 Location 9 Unit No. _____ Fuel NAT. GAS
Load 83% ~~Kl/hr~~ or MBtu/hr Filter No. 3 BLANK 4
Sample Box No. 1 Meter Box No. 1 Probe No. 1 Probe Length 4ft

Filter Heater Setting 7
Probe Heater Setting 3
Stack Moisture est. 8 %
Ambient Temperature 85 °F
Nozzle Diameter 3/8 in.
Atmospheric Pressure 29.99 in.Hg
Weather LITE CLOUDS, HOT HUMID
Stack Gas Pressure, Ps -6.4 iwg
Abs. Stack Press., AP=P$_s$ +407= 400.6 iwga
Stack Gas Sp. Gravity, Gs 1.03 n.d.
Stack Area, As 6' x 7½" ft^2
O_2 = 6.0%



Remarks
Final Meter: 1339.85
Initial Meter: 1331.92
7.93

Method 5

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
1032	1331.92	6	.09	.62	300	75	200	300	95
1037	1334.00	6.75	.09	.62	300	75	226	280	95
1042	1337.00	7.00	.09	.62	300	75	250	310	95
1047	1339.85	7.0	.09	.62	300	72	260	320	100
15									
Total					300 °F				
Avg.					°F				
					+ 460				

PROBE TEMP. °F
300
340
320
310

Ts= 760 °R

60-13
11/20/75

KVB, INC.

STACK DATA

Test No. 9-2
Engr. H. BUENING

Date 8/13/76 Location 9 Unit No. _____ Fuel N.G.
Load _____ K#/hr or MBtu/hr Filter No. 4 BLANK 5
Sample Box No. 1 Meter Box No. 1 Probe No. 1 Probe Length 4

Filter Heater Setting 7
Probe Heater Setting 3
Stack Moisture ~35 %
Ambient Temperature _____ °F
Nozzle Diameter 3/8 in. diam.
Atmospheric Pressure 29.89 in.Hg
Weather CLOUDY, HOT, HUMID
Stack Gas Pressure, Ps -6.4 iwg
Abs. Stack Press., AP=Pg+407= _____ iwga
Stack Gas Sp. Gravity, Gs 1.03 n.d.
Stack Area, As 45 ft²
4.2% O_2

Remarks
Final Meter: 1349.66
Initial Meter: 1342.24
7.42

Method 5

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
1039	1342.24	5.5	.12	.54	285	85	170	300	80
1044	1345.00	5.5	.12	.54	290	78	200	310	90
1049	1348.00	5.5	.12	.54	290	78	240	320	95
1054	1349.66				290	80	240	310	100
15									
Total					290 °F				
Avg.					°F				
					+ 460				

PROBE TEMP. °F
320
340
330
320

Ts= 750 °R

60-13
11/20/75

BRINK IMPACTOR

KVB, INC.

STACK DATA

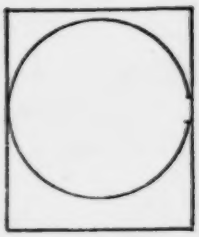
Test No. 9-1
Engr. H. BUENING

Date 8/11/76 Location 9 Unit No. _____ Fuel NAT. GAS

Load _____ K#/hr or MBtu/hr Filter No. 1

Sample Box No. 1 Meter Box No. 1 Probe No. 1 Probe Length 4

Filter Heater Setting ____
Probe Heater Setting ____
Stack Moisture ~35 %
Ambient Temperature 95 °F
Nozzle Diameter 4 mm ~~in.~~ diam.
Atmospheric Pressure 29.96 in.Hg
Weather HOT, HUMID, LITE BREEZE
Stack Gas Pressure, Ps -6.4 iwg
Abs. Stack Press., AP=P$_s$ +407= ____ iwga
Stack Gas Sp. Gravity, Gs ____ n.d.
Stack Area, As 6 - 7¾ ft²



Remarks

Final Meter: 1340.55
Initial Meter: 1339.85
.70

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
1350	1339.85	13.5	.09	.05	310	100	125	120	115
1358	1340.55	23.0							
8			PLUGGED						
Total					310 °F				
Avg.					°F				
					+ 460				

PROBE TEMP. °F
250

Ts= 770 °R

pull 10 cu. ft.

60-13

11/20/75

Test No. 9-1

CASCADE IMPACTOR DATA SHEET

BASELINE

TEST RUN NO. 9-1 LOCATION 9 DATE 8-11-76

IMPACTOR NO. 1 CYCLONE NO. 1 OPERATOR RAY

SAMPLE POINT LOCATION UPSTREAM OF PRECIPITATOR

SUBSTRATE COATING — FUEL N. G. TEST LOAD 84% klb/hr

IMPACTOR ORIENTATION VERTIC. FLOW THRU IMPACTOR .1 CFM

FLUE STATIC PRESSURE -6.4 inH_2O, VELOCITY 20.3 ft/sec. in duct

NOZZLE DIA. 4 mm IMPACTOR PRESSURE DROP 14 "H_2O END TIME 13.58

GAS METER END 1340.55 CF START TIME 13.50

GAS METER START 1339.85 CF DURATION ~ 8 min

GAS VOLUME .70 CF FLOW RATE .1 CFM

AMBIENT TEMPERATURE 95 °F PRESSURE 29.76 IN Hg. HUMIDITY 42 %

FLUE GAS MOLECULAR WT. ____, TEMP. 310 °F, DENSITY ____ g/cc, VISCOSITY ____ POISE

FLUE GAS TEMP. 310 °F

	Stage Number							Stage Blank
	1	2	3	4	5			
Foil + Sample, g	4.2899	3.7296	4.0949	3.6708	4.1842			
Unused Foil, g	4.0864	3.6825	4.0758	3.6605	4.1755			
Sample, g	.2035	.0471	.0191	.0103	.0087			
Correction for Blank, g								
Final Sample, g	.2035	.0471	.0191	.0103	.0087			
D_{pc}	2.81	1.66	1.13	.59	.37			
% OF TOTAL	35.5	8.2	3.3	1.8	1.5			
	50.3	11.8	6.6	3.3				

FILTER NO.	Sample	Blank
FILTER + SAMPLE, g	1.2199	
FILTER TARE, g	1.2200	
SAMPLE, g	-0	
CORRECTION FOR BLANK, g		
FINAL SAMPLE, g		

FULL CONTAINER, g .7310

EMPTY CONTAINER, g .4460

CYCLONE CATCH, g .2850 49.7%

CUPS .2887

.5737 g

stages + cyclone = 0.5737 g

433

60-20

~60.7% is less than 3μ.

11 51 NO. 9.1

TABLE 1. BRINK IMPACTOR

	Symbol		Value
Pressure drop across impactor during test "Hg"	ΔP_2		1.65
Static pressure at inlet to impactor, atm.	P_2		0.99
Density of aerosol particle, grams/cc	P_p		3.1
Density of gas at inlet sampling conditions, grams/cc	P_2		1.15×10^{-3}
Molecular weight of sample gas	MW_2		29
Molecular weight of calibration gas	MW_1		29
Temperature of gas at sampling conditions, °K	T_2	310°F	427
Temperature of gas at calibration conditions, °K	T_1		298
Static pressure under calibration conditions, atm.	P_1		1.0
Gas viscosity at sampling conditions, poises	μ		2.4×10^{-4}
Stage jet diameter, cm	D_{c_2}		0.249
	D_{c_3}		0.1775
	D_{c_4}		0.1396
	D_{c_5}		0.0946
	D_{c_6}		0.0731
Sample quantity collected on each cup, mg	R_2		203.5
	R_3		47.1
cyclone = 285 mg	R_4		19.1
	R_5		10.3
	R_6		8.7
GLASS WOOL FILTER CATCH, mg	R_7		0
Dimension conversion constant	g_c		1
	TOTAL SAMPLE, mg		~~573.7~~ 288.7

TABLE 2.

	Symbol	Value
Effective pressure drop, "Hg"	ΔP_E	1.49
Inlet flow to impactor, cc/second	F	29.26
Pressure out of stages, atm.	P_{S_2}	0.99
	P_{S_3}	0.99
	P_{S_4}	0.99
	P_{S_5}	0.978
	P_{S_6}	0.955
Density of gas out of the various stages, grams/cc	P_{S_2}	1.78×10^{-3}
	P_{S_3}	1.78×10^{-3}
	P_{S_4}	1.78×10^{-3}
	P_{S_5}	1.76×10^{-3}
	P_{S_6}	1.72×10^{-3}
Characteristic diameter, microns	D_{pc_2}	2.81
	D_{pc_3}	1.66
	D_{pc_4}	1.13
	D_{pc_5}	0.59
	D_{pc_6}	0.37
Criteria for validity of equation 18	$\frac{D_{pc_6} \times 10^{-4}}{L}$	5.02
Mean free path	L	7.37×10^{-6}
Average molecular velocity	$\bar{v}$	37,845

Continued

TABLE 2 (Continued)

	Symbol	Value	
% on a cup of the total sample collected	Cycl		49.7
Stage 2	γ_2	70.5	35.5
3	γ_3	16.3	8.2
4	γ_4	6.6	3.33
5	γ_5	3.6	1.8
6	γ_6	3.0	1.52
Filter	γ_7	0	
	Total	100.00*	

573.7

*Any discrepancy due to rounding off should be buried in the largest γ cumulative % smaller than D_{pc} cyclone ~ 7μ

			100
			50.35
2.81	Σ_2	29.5	14.85
1.66	Σ_3	13.2	6.65
1.13	Σ_4	6.6	3.32
.59	Σ_5	3.0	1.52
.37	Σ_6	0	0

BRINK IMPACTOR

K V B, INC.

STACK DATA

Test No. 9-2

Engr. H. BUENING

Date 8/13/76 Location 9 Unit No. _____ Fuel NAT. GAS

Load 83% ~~#/hr~~ or MBtu/hr Filter No. 2

Sample Box No. 1 Meter Box No. 1 Probe No. 1 Probe Length 4 ft.

Filter Heater Setting _____

Probe Heater Setting _____

Stack Moisture ~35 %

Ambient Temperature 92 °F

Nozzle Diameter 4 mm ~~in.~~ diam.

Atmospheric Pressure 29.87 in.Hg

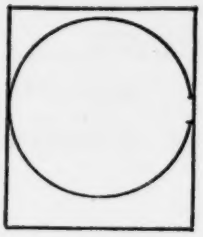
Weather CLOUDY, HOT

Stack Gas Pressure, Ps -6.3 iwg

Abs. Stack Press., AP=Ps +407=400.7 iwga

Stack Gas Sp. Gravity, Gs 1.03 n.d.

Stack Area, As 45 ft²



Remarks

Final Meter: 1350.14

Initial Meter: 1349.69

.45

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
1150	1349.69	-76	.12	.05	300	90	—	—	110
1154	1350.14	21							
4			PLUGGED						
Total					°F				
Avg.					°F				
PROBE 320					+ 460				

Ts= 760 °R

60-13

11/20/75

Test No. 9-2

CASCADE IMPACTOR DATA SHEET

TEST RUN NO. 9-2 LOCATION 9 DATE 8-13-76

IMPACTOR NO. 1 CYCLONE NO. 1 OPERATOR R. PIONESSA

SAMPLE POINT LOCATION UPSTREAM OF PRICIPITATOR

SUBSTRATE COATING NONE FUEL NAT. GAS TEST LOAD 83% ~~klb/hr~~

IMPACTOR ORIENTATION VERTICAL FLOW THRU IMPACTOR .1125 CFM

FLUE STATIC PRESSURE -6.3 inH_2O, VELOCITY 23.26 ft/sec

NOZZLE DIA. 4 mm IMPACTOR PRESSURE DROP 14 "H_2O END TIME 1154

GAS METER END 1350.14 CF START TIME 1150

GAS METER START 1349.69 CF DURATION 4 MIN

GAS VOLUME .45 CF FLOW RATE .1125 CFM

AMBIENT TEMPERATURE 92 °F PRESSURE 29.87 IN Hg. HUMIDITY 56 %

FLUE GAS MOLECULAR WT. _____, TEMP. 300 °F, DENSITY _____ g/cc, VISCOSITY _____ POISE

	Stage Number							Stage Blank
	1	2	3	4	5			
Foil + Sample, g	4.1295	3.6816	4.0867	4.1835	4.1835			
Unused Foil, g	4.0879	3.6705	4.0785	3.6692	4.1810			
Sample, g	.0416	.0161	.0082	.0043	.0025			
Correction for Blank, g								
Final Sample, g	.0416	.0161	.0082	.0043	.0025			
	.0727	.0311	.0150	.0068				

FILTER NO.	Sample	Blank
FILTER + SAMPLE, g	.0394	
FILTER TARE, g	.0387	
SAMPLE, g	.0007	
CORRECTION FOR BLANK, g	0	
FINAL SAMPLE, g	.0007	

FULL CONTAINER, g .4986

EMPTY CONTAINER, g .4328

CYCLONE CATCH, g .0658

catch 50% low re method 5

stages + cyclone = .01385 g
+ filter = .1392

60-20

TEST NO. 9-2

TABLE 1.

	Symbol	Value
Pressure drop across impactor during test "Hg"	ΔP_2	1.03
Static pressure at inlet to impactor, atm.	P_2	0.99
Density of aerosol particle, grams/cc	P_p	3.1
Density of gas at inlet sampling conditions, grams/cc	P_2	1.80×10^{-3}
Molecular weight of sample gas	MW_2	29
Molecular weight of calibration gas	MW_1	29
Temperature of gas at sampling conditions, °K	T_2	422
Temperature of gas at calibration conditions, °K	T_1	298
Static pressure under calibration conditions, atm.	P_1	1.0
Gas viscosity at sampling conditions, poises	μ	2.4×10^{-4}
Stage jet diameter, cm	D_{c_2}	0.2[illegible]
	D_{c_3}	0.1775
	D_{c_4}	0.13[illegible]
	D_{c_5}	0.0946
	D_{c_6}	0.0731
Sample quantity collected on each cup	R_2	41.6
	R_3	16.1
cyclone - 65.8	R_4	8.2
	R_5	4.3
	R_6	2.5
	R_7	0.7
Dimension conversion constant	g_c	1
	TOTAL SAMPLE, mg	~~79.4~~ 1392

TABLE 2.

	Symbol	Value
Effective pressure drop, "Hg"	ΔP_E	1.47
Inlet flow to impactor, cc/second	F	29.26
Pressure out of stages, atm.	P_{S_2}	0.99
	P_{S_3}	0.49
	P_{S_4}	0.99
	P_{S_5}	0.978
	P_{S_6}	0.955
Density of gas out of the various stages, grams/cc	P_{S_2}	1.80×10^{-3}
	P_{S_3}	1.80×10^{-3}
	P_{S_4}	1.80×10^{-3}
	P_{S_5}	1.78×10^{-3}
	P_{S_6}	1.74×10^{-3}
Characteristic diameter, microns	D_{pc_2}	2.81
	D_{pc_3}	1.66
	D_{pc_4}	1.13
	D_{pc_5}	0.60
	D_{pc_6}	0.38
Criteria for validity of equation 18	$\frac{D_{pc_6} \times 10^{-4}}{L}$	0.15
Mean free path	L	7.33×10^{-6}
Average molecular velocity	$\bar{v}$	37,627

Continued

TABLE 2 (Continued)

	Symbol	Value	
			47.3
% on a cup of the total sample collected	cyclone		
Stage 2	γ_2	56.6	29.9
3	γ_3	21.9	11.6
4	γ_4	11.2	5.9
5	γ_5	5.9	3.1
6	γ_6	3.4	1.8
Filter	γ_7	1.0	.50
	Total	100.00*	
			100.
*Any discrepancy due to rounding off should be buried in the largest γ cumulative % smaller than D_{pc}			52.8
	Σ_2	43.4	22.9
	Σ_3	21.5	11.3
	Σ_4	10.3	5.4
	Σ_5	4.4	2.3
	Σ_6	1.0	.5

PLUME OPACITY OBSERVATION RECORD

Test Run No. 9-1

LOCATION NO. 9 OBSERVER H. BUENING

OWNER _____ BOILER NO. — CAPACITY — klb/hr

DATE AUG. 11, 1976 FUEL TYPE N.G. BURNER TYPE _____

POINT OF EMISSION STACK

POINT OF OBSERVATION ~200 YARDS NORTH OF STACK

TEST No.	TEST Time am/pm	TEST Type	Test Load k#/hr	Opacity %	WIND Speed mph	WIND Direct	Sky Cond.	Sun Position	Comments
1	10:30	PARTIC.		20	NO WIND		PARTLY CLOUDY	TO THE LEFT OF OBSERVER	
	10:32	"		5					
	10:34	"		5					
	10:36	"		20					
	10:38	"		5					
	10:40	"		5					
	10:42	"		25					
	10:44	"		20					
	10:46	"		5					
	10:48	"		5					
	10:50	"		5	↓		↓		

PLUME OPACITY OBSERVATION RECORD

Test Run No. 9-2

LOCATION NO. 9 OBSERVER HANS

OWNER _____ BOILER NO. _____ CAPACITY — klb/hr

DATE 8-13-76 FUEL TYPE N. G. BURNER TYPE _____

POINT OF EMISSION STACK

POINT OF OBSERVATION 250 YARDS NORTH OF STACK

TEST No.	TEST Time am/pm	TEST Type	Test Load k#/hr	Opacity %	WIND Speed mph	WIND Direct.	Sky Cond.	Sun Position	Comments
	10:35	PARTIC.	83%	< 5	NO WIND		CLOUDY	TO THE LEFT OF OBSERVER	
	10:37	↓	↓	< 5	↓		↓		
	10:39			< 5					
	10:41			< 5					
	10:43			< 5					
	10:45			< 5					
	10:47			< 5					
	10:49			< 5					
	10:51	↓	↓	< 5	↓		↓		

PARTIC. + BRINK

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: AUG. 11, 1976 _____

Location: 9 _____

Unit: _____ _____

Test: 9-1 Personnel: _____

Fuel: _____ _____

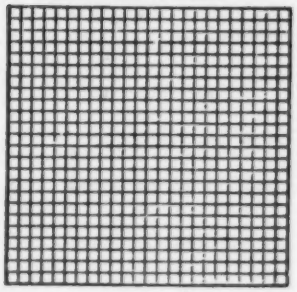
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_g = 85.48\ C_p \left[\frac{T_S \Delta P}{P_S M_S}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_S	Molecular Wt. M_S	Velocity (ft/sec) V_S	O_2 Conc. (% Dry)
		1 BAND	.55					
		2 "	.15					
		3 "	.09					
		4 "	.05					
		5 "	—					

6002-13

PARTIC. & BRINK

VELOCITY TRAVERSE

Project: _____ Test Description: _____

Date: AUG. 13, 1976 _____

Location: 9 _____

Unit: _____ _____

Test: 9-2 Personnel: _____

Fuel: _____ _____

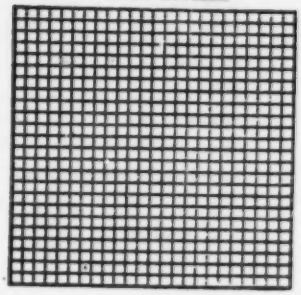
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
9:50		1 BAND	.25					
		2 "	.15					
		3 "	.12					
		4 3½"	.08					

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: 9-29-76 _____

Location: 9 _____

Unit: CEMENT KILN _____

Test: 9-3 Personnel: _____

Fuel: _____ _____

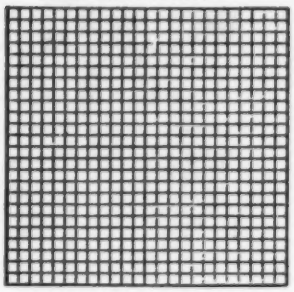
Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_g)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth (INCHES FROM TOP)	Velocity Head (in. H_2O) ΔP	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
		65	0.05					
		52	"				14	
		39	.07					
		26	0.1					
		13	0.17					

6002-13

VELOCITY TRAVERSE

Project: _____ Test Description: ___

Date: Oct. 4, 1976 _____

Location: 9 _____

Unit: KILN _____

Test: 9-5 Personnel: _____

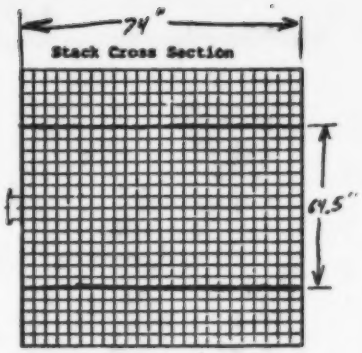
Fuel: _____ _____

Barometric Press. (in. Hg): _____

Absolute Static Press. in Stack (in. Hg): _____ (P_s)

Pitot Tube Coefficient: _____ (C_p)

$$V_s = 85.48\ C_p \left[\frac{T_s \Delta P}{P_s M_s}\right]^{1/2}$$



	Time	Traverse Point Port	Traverse Point Depth	Velocity Head (in. H_2O) ΔP	$\sqrt{\Delta P}$	Gas Temp. (°F)	Gas Temp. (°R) T_s	Molecular Wt. M_s	Velocity (ft/sec) V_s	O_2 Conc. (% Dry)
1	0900		6"	.42	.648	260 (i)			50.4	
2			1'0"	.57	.755				58.8	
3			1'6"	1.0	1.00				77.8	
✓ 4			2'0"	1.3	1.140				88.7	
5			2'6"	1.9	1.378				107.3	
6			3'0"	1.3	1.140				88.7	
7			3'6"	1.2	1.095				85.2	
8			4'0"	.92	.959				74.6	
9			4'6"	1.00	1.00				77.8	
10			5'0"	1.3	1.140				88.7	
8			4'0"	1.92	.959				74.6	
4			2'0"	1.5	1.225				95.3	
2			1'0"	.92	.959				74.6	
1			0'6"	.57	.755				58.8	
									AVG: 81.4	

SAMPLING POINT IS IN DUCT BETWEEN PRECIPITATOR & STACK USING OPACITY MONITOR PORT FOR SAMPLING. THE PORT IS DOWN STREAM OF THE I.D. FAN. OPACITY MONITOR TUBE IS A 4" DIAM. PIPE WITH 3" SLOTS CUT OUT ON OPPOSITE SIDES. SLOT ALIGNED IN DIRECTION OF FLOW. 6002-13

(i) UPSTREAM OF I.D. FAN

TABLE TRACE SPECIES AND ORGANICS SAMPLING CONDITIONS
LOCATION 9 - ROTARY CEMENT KILN

TS & O Run No.	5	6	7	8
Test Number	9-3	9-4	9-5	9-6
Date (1976)	9/29	9/30	10/4	10/5
Port Location	ESP inlet	ESP outlet	ESP outlet	ESP outlet
Velocity, m/s (f/s)	5.17 (16.95)	5.06 (16.60)	17.48 (57.35)	17.41 (57.10)
Stack Temp. K (°F)	415 (287)	425 (305)	411 (280)	409 (274)
Oxygen Content % dry	6.5	2.3	6.8	6.6
Moisture:	34.31	44.74	37.55	38.21
Sample Time, min.	75	75	300	300
Cyclone Flow, scmm (scfm)	0.102 (3.591)	0.097 (3.435)	0.087 (3.067)	0.087 (3.078)
Isokinetic Rate,	96.8	118.3	105.5	104.5
Oven Temp., K (°F)	478 (400)	478 (400)	478 (400)	478 (400)
XAD2 Temp., K (°F)	303 (85)	297 (75)	299 (77)	294 (69)
Meter Temp., K (°F)	311 (00)	319 (115)	309 (97)	310 (99)
Nozzle Size, mm (in.)	19.05 (.75)	19.05 (.75)	9.53 (.375)	9.53 (.325)
No. of Filters Used	1	1	1	1
Sample Flow, dry, scmm (scfm)	.0342 (1.382)	0.0386 (1.3631)	0.0351 (1.2384)	0.345 (1.2185)
Volume Collected, dry, scm (scf)	2.937 (103.64)	3.897 (102.33)	10.529 (371.53)	10.359 (365.55)
Total Particulates, ng/J (lb/MCM)	7307 (17.0)	5548 (12.9)	32.7 (.083)	29.47 (.069)
Unit Conditions:				
Test Time, min.	75	75	316.8	313.2
Nat. Gas Burned, 10^3 scm (10^3 scf)	7.241 (255.5)	7.754 (273.6)	27.60 (973.7)	(28.46 (1004.1)
Dry Feed, 10^6 g (10^3 lb)	76.64 (168.6)	70.61 (155.4)	293.7 (646.0)	334.2 (735.2)
Slurry Feed, 10^6 g (10^3 lb)	119.0 (261.8)	108.6 (239.0)	462.5 (1017.4)	517.3 (1138.0)
Slurry Moisture, % weight	35.6	35.0	36.5	35.4
Clinker, 10^6 g (10^3 lb)	45.75 (100.7)	42.18 (92.69)	175.0 (385.1)	199.4 (438.6)
Precipitator Catch 10^6g (10^3lb)	2.131 (4.688)	2.131 (4.688)	9.375 (20.63)	9.375 (20.63)

KVB, Inc. Trace Species and Organics Sampling Data

Project: EPA PHASE III SASS Personnel: PIONESSA, CHERRY FIELDS, WOOD Barometric Press: 29.85

Date: ~~9/28/76~~ 9-29-76

Location: 9

Unit: ROTARY KILN Probe Nozzle Diameter (inches): _____ (Dn)

Test: 9-3 Absolute Static Press. in Stack (in. Hg): 28.41 (Pa)

Fuel: NAT. GAS Pitot Tube Coefficient: _____ (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
1640	~~0~~	~~4~~ ft	.06	1.2	598.965	6.0	278	406	90	89	402	100	100	
1655	15	"	.06	1.2	620.800	7.5	292	409	86	99	397	101	101	
1710	30	"	.06	1.2	642.400	9.9	293	404	86	87	399	104	98	
1725	45	"	.06	1.2	664.200	13.0	288	402	83	80	398	100	97	
1740	60	"	.07	1.2	686.000	17.2	288	402	80	74	396	99	96	
1755	75	"	.10	1.2	708.313	22.5	284	402	87	73	396	98	96	
	CHANGED FILTER + DESSICANT													
	75				708.313									
	LOOKED AT 1 MICRON CYCLONE, IT WAS COMPLETELY													
FILLED, CONCLUDED TEST AT THIS POINT.														

KVB 6002-12

KVB, Inc. Trace Species and Organics Sampling Data

Project: EPA PHASE III SASS Personnel: PIONESSA, CHERRY FIELDS, WOOD Barometric Press: 29.93

Date: 9/30/76

Location: 9

Unit: CEMENT KILN Probe Nozzle Diameter (inches): _____ (Dn)

Test: 9-4 Absolute Static Press. in Stack (in. Hg): _____ (Ps)

Fuel: NATURAL GAS Pitot Tube Coefficient: _____ (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
1329	0	4 pt	.06	1.2	712.926	5.2	308	406	75	104	415	118	116	
1344	15	"	.06	1.2	735.400	7.0	295	407	79	98	401	120	116	
1359	30	"	.06	1.2	757.700	8.5	299	403	82	96	399	110	111	
1414	45	"	.07	1.2	779.700	11.0	304	403	74	95	401	115	111	
1429	60	"	.065	1.2	801.700	14.0	314	404	73	100	401	118	112	
1444	75	"	.070	1.2	823.548	22.5	308	401	69	101	402	119	114	

KVB 6002-12

PAGE I

KVB, INC. TRACE SPECIES AND ORGANICS SAMPLING DATA

Project: EPA PHASE II SASS Personnel: PIONESSA, HAGERTY CARTER, CHERRY Barometric Press: _____

Date: 10/4/76

Location: 9

Unit: CEMENT KILN Probe Nozzle Diameter (inches): 3/8 (Dn)

Test: 9-5 Absolute Static Press. in Stack (in. Hg): _____ (Ps)

Fuel: NAT. GAS Pitot Tube Coefficient: _____ (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
1517	0	18 in	.75	1.2	861.179	4.5	277	395	76	86	371	101	106	
1532	15	"	.8	.9	883.200	4.5	278	396	86	80	389	101	104	
1547	30	"	.8	.9	902.900	4.2	284	396	79	77	399	101	102	
1602	45	"	.8	.9	922.400	4.1	292	400	76	79	401	101	101	
1617	60	"	.8	.9	941.700	4.1	293	402	78	80	401	101	101	
		CHANGED DESSICANT												
1620	60	"	.8	.9	941.700	3.6	292	401	71	91	402	99	100	
1635	75	"	.8	.9	961.500	3.8	289	403	74	81	402	100	99	
1650	90	"	.8	.9	981.400	4.0	285	404	76	82	400	101	100	
1705	105	"	.8	.9	001.900	4.1	282	403	72	85	401	98	98	
1720	120	"	.8	.9	021.100	4.2	279	402	81	84	401	99	98	
1735	135	"	.8	.9	040.200	4.4	277	402	75	85	401	99	98	
		CHANGED DESSICANT												
1738	135	"	.8	.9	040.200	5.0	278	400	77	92	402	98	98	
1753	150	"	.8	.9	062.200	5.3	278	403	76	85	402	99	98	
1808	165	"	.8	.9	079.700	5.5	275	402	78	82	400	100	97	

KVB 6002-12

PAGE II

KVB, INC. TRACE SPECIES AND ORGANICS SAMPLING DATA

Project: EPA PHASE III SASS Personnel: PIONFSSA, HAGERTY CARTER, CHERRY Barometric Press: 29.7

Date: 10/4/76

Location: 9

Unit: CEMENT KILN Probe Nozzle Diameter (inches): 3/8 (Dn)

Test: 9-5 Absolute Static Press. in Stack (in. Hg): _____ (Ps) P_{stack} = -.13 "H_2O

Fuel: NAT. GAS Pitot Tube Coefficient: .84 (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
1823	180	18" in	.8	.9	098.1	5.6	276	401	82	83	400	97	96	
1838	195	18" in	.8	.9	117.158	5.6	275	399	80	85	400	95	94	
		STOP TEST - EMPTY 1st IMPINGER AND REFILL WITH SOLUTION CHANGED DESSICANT												
1848	195	"	.8	.9	117.158	5.0	274	403	74	90	404	92	94	
1903	210	"	.8	.9	136.990	5.0	273	401	83	78	400	93	93	
1918	225	"	.8	.9	156.700	5.0	273	401	73	76	400	94	92	
1933	240	"	.8	.9	175.110	5.0	272	400	74	78	399	93	91	
1948	255	"	.8	.9	194.910	5.0	273	400	77	78	400	93	91	
2003	270	"	.8	.9	214.400	5.2	274	399	77	78	400	92	90	
2018	285	"	.8	.9	233.400	5.2	274	401	82	82	400	93	90	
2033	300	"	.8	.9	253.100	5.5	276	401	80	86	399	93	90	

KVB 6002-12

PAGE I

KVB, Inc. Trace Species and Organics Sampling Data

Project: EPA PHASE III SASS Personnel: PHARISSA, HAGERTY CHERRY, CARTER Barometric Press: 29.78 1800 HRS

Date: 10/5/76

Location: 9

Unit: CEMENT KILN Probe Nozzle Diameter (inches): 3/8 (Dn)

Test: 9-6 Absolute Static Press. in Stack (in. Hg): _____ (Ps)

Fuel: NAT. GAS Pitot Tube Coefficient: _____ (Cp)

FILTER 276

T_w = 69 °F

T_a = 77°F

RH = 68%

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In/Out		
1248	0	18 in	.8	.9	256.288	5.6	270	402	66	89	403	96	96	
1303	15	"	.8	.9	276.200	5.7	269	398	66	77	398	98	97	
1318	30	"	.8	.9	295.000	5.7	271	399	69	80	399	99	99	
1333	45	"	.8	.9	313.900	5.9	278	395	70	82	400	102	100	
1348	60	"	.8	.9	333.200	6.0	280	404	69	86	401	106	103	
1403	75	"	.8	.9	352.800	6.0	282	404	71	85	401	105	104	
1418	90	"	.8	.9	372.400	6.1	279	404	72	81	400	105	105	
1433	105	"	.8	.9	391.100	6.1	279	405	70	83	401	102	104	
1448	120	"	.8	.9	410.700	6.2	276	404	71	80	397	101	102	
1503	135	"	.8	.9	430.000	6.3	278	403	71	76	400	99	100	
1518	150	"	.8	.9	449.300	6.5	276	402	68	77	397	99	99	
1533	165	"	.8	.9	469.500	6.6	276	402	73	80	397	98	99	
			CHANGE DESSICANT + EMPTIED 1ST IMP. REFILLED WITH NEW SOLUTION											
1543	165	"	.8	.9	469.500	3.5	← LEAK							
1545	167	"	.8	.9	473.160	STOPPED TEST TO CHECK LEAK								
1548	167	"	.8	.9	473.160	5.2	277	403	66	78	397	96	97	

KVB 6002-12

PHASE II

KVB, INC. TRACE SPECIES AND ORGANICS SAMPLING DATA

Project: EPA PHASE II SASS Personnel: PIONESSA, HAGERTY CHERRY, CARTER Barometric Press: _____

Date: 10/5/70

Location: 9

Unit: CEMENT KILN Probe Nozzle Diameter (inches): _____ (Dn)

Test: 9-6 Absolute Static Press. in Stack (in. Hg): _____ (Ps)

Fuel: NATURAL GAS Pitot Tube Coefficient: _____ (Cp)

TIME		Traverse Point Depth	Pitot ΔP (in H_2O)	Orifice ΔP (in H_2O)	Cum. Meter Volume (ft^3)	Pump Suction (in. Hg)	TEMPERATURE (°F)							O_2 Conc. % dry
Real	Elapsed						Stack	Probe	XAD-2	Impinger Out	Oven	Meter In	Meter Out	
~~1603~~	~~182~~	~~18 m.~~	~~.8~~	~~.9~~										
1611	190	"	.8	.9	502.903	5.5	276	400	65	73	396	98	97	
1626	205	"	.8	.9	520.600	6.0	273	403	67	73	396	97	97	
1641	220	"	.8	.9	540.000	6.0	270	402	67	73	398	97	96	
1656	235	"	.8	.9	560.000	6.0	272	401	68	73	401	96	96	
1711	250	"	.8	.9	578.000	6.0	270	402	66	75	398	96	95	
1726	265	"	.8	.9	598.900	6.0	267	402	71	76	399	97	95	
1741	280	"	.8	.9	617.600	6.2	269	402	69	74	323	95	94	
1801	300	"	.8	.9	642.880	6.2	271	402	70	75	274	96	94	

KVB 6002-12

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 9-3 Date 9/29/76 Location 9 CEMENT KILN

Sample Port Position INLET TO ESP

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
	384	S P+N+10μ SOLID	4oz NAL	20.2857g	63.78g
	386	S 3μ SOLID	"	23.5244g	
	393	S 1μ SOLID	"	15.6894g	
	273	S #1 FILTER	PETRI	4.2785g	152.9796g Total
G *	253	L P+N+10μ WASH	8oz A	208ml	
	254	L "	"	199ml	
	256	L "	"	150ml	1381ml Tot
	257	L "	"	203ml	
	255	L 3μ WASH	"	173ml	
	258	L 1μ WASH	"	140ml	
	259	L FILTER HOUS. WASH	"	197ml	
	261	L " "	"	116ml	
H *	213	L XAD-2 MOD RINSE	16oz A	449ml	823ml
	222	L "	"	374ml	
	296	S XAD-2 RESIN	16oz AWM	150g	429g-279
I *	441	L XAD-2 CONDENSATE	1l N	990ml	1089ml Tot.
	442	L "	1l N	99ml	
⊗	LOST (311)	X IMPINGER #1 (1)	1l N	696ml	1465ml after 830ml before
J	437	L IMPINGER #1 (2)	1l N	769ml	695ml Rinse added
K *	330	L IMPINGER #2 (1)	1l N	828ml	1585ml After 1550ml Before
	438	L " #2 (2)	1l N	757ml	35ml Rinse
	NONE	X IMPINGER #3			
	837	L IMPINGER #1 (1)	8-16oz A?	— combine with #437	
⊗	260	LB Freon TF Blank	8oz Amb	134ml	
	262	LB IPA Blank	"	81ml	Rinse Blank
	263	LB Silv. Nit & Amm Per Blk	"	168ml	Imp 2 Blank
	1016	P CEMENT FEED SLURRY	GLASS	1195.5g	
	1017	P CEMENT CLINKER	GLASS	946.8g	

* - combine samples indicated - one analysis

⊗ - DO NOT ANALYZE
#311 - Not Sent To Calspan
#260

Data Sheet KVB 6002-15

COUNT S - 5 TRAIN SOLIDS
L - 6 TRAIN LIQUIDS
LB - 2 BLANKS
P - 2 PROCESS SOLIDS

9-3 SSHS
SAMPLE COMB.

KVB

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 9-3 Date 9/29/16 Location 9 CEMENT KILN (WET)

Sample Port Position INLET TO ESP.

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
A.	384	S P+N+10μ SOLID		20.2857	SAMPLE FRACTIONS
	386	3μ SOLID		28.5244	35.9
	393	1μ SOLID		15.6844	24.6
	273	# 1 FILTER		4.2795	6.7
				63.7780	100. %
B	296	S XAD-2 RESIN		150 g	100%
C	AA-H/213	L XAD-2 MeOH RINSE		449 ml	9.0
	222	XAD-2 MeOH RINSE		374 ml	7.5
	AA-I/441	XAD-2 CONDENSATE		990 ml	20.0
	442	"		99 ml	2.0
	AA-J/437	IMPINGER #1		769 ml	15.5
	330	IMPINGER #2		828 ml	16.7
	438	IMPINGER #2		757 ml	15.3
				49.2 ml	100. %
D	1016	P CEMENT SLURRY			100%
E	1017	P CEMENT CLINKER			100%
F	1020	P ESP CATCH FROM TEST 9-1			100%
	COUNT	S = 2 SOLIDS			
		L = 1 LIQUID			
		P = 3 SOLIDS			
		6 ANAL			

Data Sheet KVB 6002-15

Test 9-3			TABLE			Inlet to ESP		
POLLUTANT	SAMPLE NUMBER							
	384*	386*	393*	273*	G*	H*	296*	I*
Antimony	<50	<50	<50	<50	0.2	<0.1	<50	<0.1
Arsenic	2.0	1.6	3.0	4.0	<0.02	<0.02	<0.5	<0.02
Barium	<20	<20	<20	<20	<0.1	<0.1	<20	<0.1
Beryllium	<0.5	0.6	1.2	2.9	<0.005	<0.005	1.3	<0.005
Cadmium	4.4	4.6	4.7	5.1	0.01	0.01	1.3	<0.01
Calcium	310000	420000	250000	250000	560	24	32000	6.3
Chromium	31	20	31	80	0.07	0.03	3	<0.02
Cobalt	38	24	30	55	0.08	0.02	15	<0.02
Copper	11	11	13	17	0.04	0.08	15	0.01
Iron	12000	13000	18000	22000	19.0	3.2	100	0.68
Lead	<200	<200	<200	<200	0.18	<0.02	<200	<0.02
Manganese	82	83	70	140	0.18	0.061	17	0.038
Mercury	<0.2	<0.2	<0.2	<0.2	<0.005	<0.005	<0.2	<0.005
Nickel	24	30	30	39	0.11	0.07	5	<0.02
Selenium	<4	<4	<4	<4	<0.04	<0.04	<4	<0.04
Tellurium	<50	<50	<50	<50	<2	<2	<50	<2
Tin	<50	<50	<50	<50	<1	<1	<50	<1
Titanium	1900	2100	2700	3000	0.9	<0.5	100	<0.5
Vanadium	30	30	55	90	<0.1	<0.1	<10	<0.1
Zinc	40	42	40	45	0.08	0.21	20	0.06
Chloride	709	1210	2810	21400	11.7	10.6	35.6	2.12
Fluoride	150	292	256	418	3.8	0.26	60.9	0.34
Nitrates	8.69	8.08	13.0	27.8	<0.2	0.44	3.04	0.50
Sulfates	<50	<50	<50	51600	<6	2	53.6	10
					253,254 256,257 255,258 259,261	213 222		441 442

* ug/g
* ug/ml

Test 9-3	TABLE					Inlet to ESP	
POLLUTANT	SAMPLE NUMBER						
	437*	J*	262*	263*	1016+	1017+	837*
Antimony	0.4	0.8	<0.1	1.2	<25	<50	<0.1
Arsenic	<0.02	<0.02	0.03	<0.02	1.7	1.7	0.010
Barium	<0.1	<0.1	<0.1	<0.1	<15	<20	<0.5
Beryllium	<0.005	<0.005	<0.005	<0.005	0.3	1.4	<0.006
Cadmium	<0.01	0.02	<0.01	0.02	1.7	5.4	<0.01
Calcium	0.28	0.35	<0.02	0.55	240000	450000	1
Chromium	<0.02	0.15	<0.02	<0.02	10	31	0.06
Cobalt	<0.02	0.04	<0.02	0.05	10	26	<0.02
Copper	0.02	0.03	<0.01	0.02	14	18	<0.02
Iron	0.16	0.80	0.06	0.13	13000	23000	0.3
Lead	0.02	0.06	0.02	0.07	<100	<200	<0.1
Manganese	0.021	0.010	<0.01	<0.01	50	140	0.01
Mercury	<0.005	<0.005	<0.005	<0.005	<0.1	<0.2	<0.003
Nickel	<0.02	0.10	0.02	0.06	10	23	<0.02
Selenium	<0.04	<0.04	<0.04	<0.04	<4	<4	<0.005
Tellurium	<2	<2	<2	<2	<25	<50	<0.5
Tin	<1	<1	<1	<1	<25	<50	<0.5
Titanium	<0.5	<0.5	<0.5	<0.5	1100	2400	<0.5
Vanadium	<0.1	<0.1	<0.1	<0.1	27	65	<0.02
Zinc	0.06	0.06	<0.01	0.04	11	35	<0.01
Chloride	<0.4	214	<0.4	14.9	93.1	12.0	<0.4
Fluoride	<0.2	<0.2	—	<0.2	66.7	54.0	<0.2
Nitrates	2.32	<0.2	<0.2	<0.2	<1	<1.2	3.36
Sulfates	<6	16000	<6	22000	41.7	<40	<6

330
438

+ mg/g
* mg/l

KVB ANALYSIS DATA

Test 9-3	Sample Number	POM's	PCB's
	263	< 10 ug/l	< 1 ug/l
	273	< 1 ug/g	< 1 ug/g
	296	< 1 ug/g	< 1 ug/g
	384	0.1 ug/g	< 1 ug/g
	386	0.1 ug/g	< 1 ug/g
	393	< 0.1 ug/g	< 1 ug/g
	437	< 10 ug/l	< 1 ug/l
	837	< 10 ug/l	< 1 ug/l
	1016	0.5 ug/g	< 1 ug/g
	1017	< 0.1 ug/g	< 1 ug/g
	G	10 ug/l	< 1 ug/l
	H	256 ug/l	< 1 ug/l
	I	17 ug/l	< 1 ug/l
	J	64 ug/l	< 1 ug/l

G	253, 254, 256, 257, 255, 258, 259, 261
H	213, 222
I	441, 442
J	330, 438

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 798-9494
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14235 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9221

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-3 A #384, 386, 393, 273

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	4	Terbium	0.2	Ruthenium		Vanadium	40
Thorium	4	Gadolinium	0.9	Molybdenum	1	Titanium	930
Bismuth	0.5	Europium	0.5	Niobium	8	Scandium	5
Lead	30	Samarium	2	Zirconium	34	Calcium	MC
Thallium	3	Neodymium	3	Yttrium	8	Potassium	MC
Mercury	NR	Praseodymium	1	Strontium	100	Chlorine	900
Gold		Cerium	28	Rubidium	140	Sulfur	MC
Platinum		Lanthanum	25	Bromine	20	Phosphorus	820
Iridium		Barium	200	Selenium	1	Silicon	MC
Osmium		Cesium	35	Arsenic	22	Aluminum	MC
Rhenium		Iodine	22	Germanium	0.5	Magnesium	MC
Tungsten	≤1	Tellurium		Gallium	8	Sodium	MC
Tantalum		Antimony	≤0.8	Zinc	30	Fluorine	≈560
Hafnium	1	Tin	0.7	Copper	10	Oxygen	NR
Lutetium	0.2	Indium	STD	Nickel	10	Nitrogen	NR
Ytterbium	1	Cadmium	≤0.4	Cobalt	6	Carbon	NR
Thulium	0.2	Silver	0.4	Iron	MC	Boron	6
Erbium	0.5	Palladium		Manganese	40	Beryllium	0.3
Holmium	0.7	Rhodium		Chromium	36	Lithium	13
Dysprosium	1					Hydrogen	NR

NR – Not Reported
All elements not reported <0.2 ppm weight

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 9-3 B #296

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	≤1	Titanium	*10
Bismuth		Europium		Niobium		Scandium	≤0.4
Lead	≤2	Samarium		Zirconium		Calcium	100
Thallium		Neodymium		Yttrium		Potassium	580
Mercury	NR	Praseodymium		Strontium	0.7	Chlorine	6
Gold		Cerium		Rubidium	0.7	Sulfur	5
Platinum		Lanthanum		Bromine	≤7	Phosphorus	13
Iridium		Barium	4	Selenium	≤2	Silicon	30
Osmium		Cesium	1	Arsenic	≤0.3	Aluminum	8
Rhenium		Iodine	≤4	Germanium		Magnesium	65
Tungsten		Tellurium		Gallium	≤0.4	Sodium	100
Tantalum		Antimony		Zinc	6	Fluorine	=25
Hafnium		Tin		Copper	3	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium	≤0.9	Cobalt	≤0.1	Carbon	NR
Thulium		Silver	≤0.5	Iron	7	Boron	4
Erbium		Palladium		Manganese	1	Beryllium	
Holmium		Rhodium		Chromium	3	Lithium	*1
Dysprosium						Hydrogen	NR

*Heterogeneous
NR – Not Reported
All elements not reported <0.5 ppm weight

Approved: M Jacobs

Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 630 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14235 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 325
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-3 C #213, 222, 441, 442, 437, 330, 438,

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.009
Thorium		Gadolinium		Molybdenum	0.02	Titanium	≤0.1
Bismuth	≤0.008	Europium		Niobium		Scandium	≤0.005
Lead	0.04	Samarium		Zirconium	0.01	Calcium	MC
Thallium		Neodymium	0.02	Yttrium	≤0.003	Potassium	MC
Mercury	NR	Praseodymium	≤0.02	Strontium	0.009	Chlorine	3
Gold		Cerium	0.02	Rubidium	0.1	Sulfur	MC
Platinum		Lanthanum	≤0.03	Bromine	0.04	Phosphorus	0.8
Iridium		Barium	0.02	Selenium	≤0.1	Silicon	1
Osmium		Cesium	0.01	Arsenic	0.004	Aluminum	0.5
Rhenium		Iodine	0.2	Germanium	≤0.002	Magnesium	0.9
Tungsten		Tellurium		Gallium	0.006	Sodium	MC
Tantalum	≤0.2	Antimony	0.08	Zinc	0.4	Fluorine	MC
Hafnium		Tin	0.02	Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.08	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver	MC	Iron	0.9	Boron	0.01
Erbium		Palladium		Manganese	0.05	Beryllium	
Holmium		Rhodium		Chromium	0.1	Lithium	0.004
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.004 µg/ml

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 298 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-278-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 9, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-3 D #1016 1/27/77

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	3	Terbium	0.2	Ruthenium		Vanadium	32
Thorium	4	Gadolinium	1	Molybdenum	1	Titanium	MC
Bismuth	0.4	Europium	0.4	Niobium	5	Scandium	2
Lead	5	Samarium	2	Zirconium	35	Calcium	MC
Thallium		Neodymium	6	Yttrium	5	Potassium	MC
Mercury	NR	Praseodymium	2	Strontium	140	Chlorine	24
Gold		Cerium	17	Rubidium	8	Sulfur	22
Platinum		Lanthanum	22	Bromine	0.6	Phosphorus	820
Iridium		Barium	150	Selenium	≤0.7	Silicon	MC
Osmium		Cesium	1	Arsenic	9	Aluminum	MC
Rhenium		Iodine	3	Germanium	≤0.2	Magnesium	MC
Tungsten		Tellurium		Gallium	6	Sodium	MC
Tantalum		Antimony		Zinc	28	Fluorine	≈300
Hafnium		Tin	0.9	Copper	23	Oxygen	NR
Lutetium		Indium	STD	Nickel	9	Nitrogen	NR
Ytterbium		Cadmium	0.4	Cobalt	4	Carbon	NR
Thulium		Silver		Iron	MC	Boron	7
Erbium		Palladium		Manganese	240	Beryllium	0.7
Holmium	0.5	Rhodium		Chromium	24	Lithium	12
Dysprosium	1					Hydrogen	NR

NR – Not Reported
All elements not reported <0.2 ppm weight

Approved: M Spacek

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 738-0454
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14338 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9321

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 9-3 E #1017

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	2	Terbium	0.3	Ruthenium		Vanadium	30
Thorium	4	Gadolinium	0.9	Molybdenum	1	Titanium	500
Bismuth		Europium	0.4	Niobium	4	Scandium	2
Lead	3	Samarium	3	Zirconium	50	Calcium	MC
Thallium		Neodymium	5	Yttrium	5	Potassium	MC
Mercury	NR	Praseodymium	2	Strontium	75	Chlorine	47
Gold		Cerium	9	Rubidium	3	Sulfur	40
Platinum		Lanthanum	16	Bromine	0.5	Phosphorus	810
Iridium		Barium	80	Selenium	≤0.6	Silicon	MC
Osmium		Cesium	<0.1	Arsenic	5	Aluminum	MC
Rhenium		Iodine	0.3	Germanium	≤0.2	Magnesium	MC
Tungsten		Tellurium		Gallium	4	Sodium	MC
Tantalum		Antimony	≤0.3	Zinc	28	Fluorine	≈440
Hafnium		Tin	0.4	Copper	6	Oxygen	NR
Lutetium		Indium	STD	Nickel	5	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	3	Carbon	NR
Thulium	0.1	Silver		Iron	MC	Boron	1
Erbium	0.4	Palladium		Manganese	64	Beryllium	<0.1
Holmium	0.6	Rhodium		Chromium	20	Lithium	3
Dysprosium	0.9					Hydrogen	NR

NR – Not Reported
All elements not reported <0.2 ppm weight

Approved: M Sproles

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 9-4 Date 9/30/76 Location 9 CEMENT KILN

Sample Port Position INLET TO ESP

	Container Number		Sample Description	Container Type	Net wt/vol.	Comment
	394	S	P+N+10μ SOLIDS	4oz Nal	17.6210g	54.17g
	410	S	3μ SOLIDS	"	19.4157g	
	407	S	1μ SOLIDS	"	18.6896g	
	274	S	#1 FILTER	PETRI	4.4689g	147.9764g TOT.
A *	265	L	P+N+10μ WASH	8oz A ✓	197ml	
	270	L	"	"	170ml	
	271	L	"	"	178ml	
	272	L	"	"	184ml	1625ml TOT.
	355	L	3μ WASH	"	200ml	
	356	L	3μ WASH	"	128ml	
	357	L	1μ WASH	"	186ml	
	358	L	1μ WASH	"	196ml	
	359	L	FILTER HOUSE WASH	"	186ml	
	221	L	XAD-2 HOD RINSE	16Oz A	307ml	
	299	S	XAD-2 RESIN	16Oz AWM	1485g	427.3g-RTD
B *	446	L	XAD-2 CONDENSATE	1 L N	928g	1708ml.
	447	L	"	"	776ml	
⊗	LOST 486	X	IMPINGER #1	"	829ml	929-TBT=42
	BBB		IMPINGER #1	8oz AWM	829ml	
C *	443	L	IMPINGER #2 (1)	1 L N	952	1214 AFTER RINSE 787 BEFORE RINSE
	444	L	IMPINGER #2 (2)	"	262	427 RINSE
	NONE		IMPINGER # 3			
	1018	P	CEMENT FEED SLURRY	GLASS	1286.2g	
	1019	P	CEMENT CLINKER	"	702.3g	
	1020	P	E.STAC. CATCH	"	698.5g	
	COUNT	S - 5 TRAIN SOLIDS				
		L - 5 TRAIN LIQUIDS				
		P - 3 PROCESS SOLIDS				

13 ANALYSES
23 BOTTLES SENT

Data Sheet KVB 6003-13

Test 9-4	TABLE				Inlet to ESP			
POLLUTANT	SAMPLE NUMBER							
	394+	410+	407+	274+	A*	221*	299+	B*
Antimony	<50	<50	<50	<50	0.3	<0.1	<50	<0.1
Arsenic	<0.5	2.5	1.0	1.0	0.04	<0.02	<0.5	<0.02
Barium	<20	<20	<20	<20	<0.1	<0.1	<20	<0.1
Beryllium	1.7	2.0	1.5	2.3	<0.005	<0.005	<0.5	<0.005
Cadmium	4.5	3.0	3.7	3.6	0.015	<0.01	<1	0.015
Calcium	480000	260000	290000	210000	300	1.6	50	1.8
Chromium	21	18	32	42	0.02	0.02	<1	<0.02
Cobalt	36	31	34	34	0.03	<0.02	<5	<0.02
Copper	14	12	14	17	0.03	0.02	4	<0.01
Iron	10000	10000	17000	22000	8.3	OH 6	<50	0.16
Lead	<200	<200	<200	<200	0.09	0.02	<200	<0.02
Manganese	90	48	65	100	0.090	0.020	<5	0.010
Mercury	<0.2	<0.2	<0.2	<0.2	<0.005	<0.005	0.5	<0.005
Nickel	29	22	29	31	0.03	0.04	<3	<0.02
Selenium	<4	<4	<4	<4	<0.04	<0.04	<4	<0.04
Tellurium	<50	<50	<50	<50	<2	<2	<50	<2
Tin	<50	<50	<50	<50	<1	<1	<50	<1
Titanium	1900	2000	2600	3000	<0.5	<0.5	<100	<0.5
Vanadium	40	50	70	80	<0.1	<0.1	<10	<0.1
Zinc	40	35	41	42	0.07	0.05	<2	0.05
Chloride	986	1360	3220	23500	2.12	2.12	<4	0.42
Fluoride	139	155	222	239	0.48	<0.4	31.4	0.34
Nitrates	6.61	7.29	8.44	15.5	<0.2	<0.2	<1.8	0.26
Sulfates	49.6	<50	173	33200	6	6	53.4	<6
					265,270, 271,272 355,356 357,358 359			446,447

Test 9-4			TABLE		Inlet to ESP			
POLLUTANT	SAMPLE NUMBER							
	C*	1018+	1019+	1020+	838*			
Antimony	1.2	<30	<50	<50	<0.1			
Arsenic	<0.02	2.2	1.5	1.5	<0.02			
Barium	<0.1	<15	<20	<20	<0.1			
Beryllium	<0.005	0.4	2.0	1.8	<0.005			
Cadmium	0.025	0.7	4.0	4.1	<0.01			
Calcium	0.58	90000	520000	300000	0.42			
Chromium	0.02	6	27	20	0.02			
Cobalt	0.05	17	39	31	<0.02			
Copper	0.02	4	14	10	0.03			
Iron	0.17	7100	20000	11000	0.30			
Lead	0.08	<120	<200	<200	0.03			
Manganese	0.010	51	110	50	<0.01			
Mercury	<0.005	<0.1	<0.2	<0.2	<0.005			
Nickel	0.02	12	29	22	<0.02			
Selenium	<0.04	<4	<4	<4	<0.04			
Tellurium	<2	<30	<50	<50	<2			
Tin	<1	<30	<50	<50	<1			
Titanium	<0.5	1100	2200	2100	<0.5			
Vanadium	<0.1	17	50	40	<0.1			
Zinc	0.06	15	31	30	0.06			
Chloride	23.8	73	43.2	2950	<0.4			
Fluoride	<0.2	41.5	79.6	115	<0.2			
Nitrates	<0.2	<1.5	<1.5	8.97	1.58			
Sulfates	23200	73.6	<45	<45	<6			

443,444

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8494
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14035 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 9-4 F #1020

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤4	Terbium	0.2	Ruthenium		Vanadium	38
Thorium	≤4	Gadolinium	0.5	Molybdenum	1	Titanium	MC
Bismuth	≤0.4	Europium	0.3	Niobium	5	Scandium	3
Lead	18	Samarium	2	Zirconium	33	Calcium	MC
Thallium	2	Neodymium	6	Yttrium	6	Potassium	MC
Mercury	NR	Praseodymium	3	Strontium	160	Chlorine	850
Gold		Cerium	13	Rubidium	200	Sulfur	MC
Platinum		Lanthanum	10	Bromine	13	Phosphorus	390
Iridium		Barium	100	Selenium	≤1	Silicon	MC
Osmium		Cesium	20	Arsenic	5	Aluminum	MC
Rhenium		Iodine	9	Germanium	0.2	Magnesium	MC
Tungsten		Tellurium		Gallium	8	Sodium	MC
Tantalum		Antimony		Zinc	33	Fluorine	≈200
Hafnium		Tin	≤0.5	Copper	8	Oxygen	NR
Lutetium		Indium	STD	Nickel	9	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	1	Carbon	NR
Thulium		Silver		Iron	MC	Boron	5
Erbium		Palladium		Manganese	290	Beryllium	0.3
Holmium		Rhodium		Chromium	25	Lithium	11
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.2 ppm weight

Approved: M Jacobs

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG
REVISED 2/28/77

Test No. 9-5 Date 10/4/76 Location @ CEMENT KILN

Sample Port Position OUTLET OF ESP

NO SSMS ON THESE SAMPLES

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
E *	400	S P+N+10μ SOLIDS	4oz N.	0.0214g	DISSOLVE IN 459
	459	L P+N+10μ WASH	16 Oz A.	324ml.	
		3μ SOLIDS	NONE		
	455	L 3μ WASH	16oz. A	271ml.	
F *	415	S 1μ SOLIDS	4oz N	0.4049g	DISSOLVE IN 458
	458	L 1μ WASH	16oz A	148ml.	
	275	S #1 FILTER	PETRI	0.1859g	137.1855g TOT.
	365	L FILT. HOUS. WASH	8oz A	15ml.	
	223	L XAD MOD RINSE	16Oz A	876ml	
	300	S XAD RESIN	16 OzAWM	158g	437-279(tare)
A *	220	L XAD CONDENSATE	16 Oz A	186ml	2275 ml TOT
	439	L " "	1 l N	1036ml	
	445	L "	1 l N	1053ml	
B *	1024	L IMPINGER #1 (1)	1 gal GLASS	549ml	4363 (1500 ml orig). 4065
	1025	L " #1 (2)	"	3814ml	298 RINSE
	1026	L IMPINGER #2	"	1843ml	-1164 = 679 RINSE
C *	224	L IMPINGER #3 (1)	16oz A	174ml	1121-305-816 RINSE
	440	L IMPINGER #3 (2)	1 l. N	947ml	
D *	363	L H_2O IMPINGER WASH 2 & 3	8oz A	148ml	579.
	454	L " " "	16oz A	431ml	
	364	LB 1PA BLANK	8oz A	96ml	
	1021	P CEMENT FEED SLURRY	GLASS	8298g	
	1022	P CEMENT CLINKER	"	768.5g	
	1023	P ESP CATCH	"	4948g	
	COUNT	S - 2 SOLID	23 BOTTLES SENT		
		L - 10 LIQUIDS	* COMBINE SAMPLES INDICATED		
		LB - 1 LIQ. BLANK			
		P - 3 PROCESS SOLIDS			

16 ANALYSES

Data Sheet KVB 6002-15

Test 9-5			TABLE			Outlet of ESP		
POLLUTANT	SAMPLE NUMBER							
	275+	223*	300+	A*	B*	1026*	C*	D*
Antimony	<500	<0.1	<50	<0.1	<0.1	1.3	0.5	<0.1
Arsenic	25	0.02	<0.5	<0.02	<0.02	<0.02	<0.02	<0.02
Barium	<40	<0.1	30	<0.1	<0.1	<0.1	<0.1	<0.1
Beryllium	8	<0.005	0.5	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	20	<0.01	1.5	<0.01	<0.01	0.015	0.020	0.010
Calcium	440000	1.1	31000	0.63	1.0	1.3	0.71	2.4
Chromium	420	0.22	3	<0.02	0.02	0.27	0.24	<0.02
Cobalt	250	0.03	15	<0.02	0.06	0.11	0.07	<0.02
Copper	50	0.02	4	0.01	0.01	0.02	0.02	0.04
Iron	14000	1.1	250	0.14	0.19	1.6	0.90	0.10
Lead	<2000	<0.02	<200	<0.02	0.05	0.11	0.16	<0.02
Manganese	350	0.22	10	0.080	0.046	0.060	0.035	<0.01
Mercury	<2	<0.005	<0.2	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	220	0.11	8	0.02	<0.02	0.16	0.11	<0.02
Selenium	<4	<0.04	<4	<0.04	<0.04	<0.04	<0.04	<0.04
Tellurium	<500	<2	<50	<2	<2	<2	<2	<2
Tin	<500	<1	<50	<1	<1	<1	<1	<1
Titanium	3500	<0.5	150	0.7	<0.5	<0.5	<0.5	<0.5
Vanadium	<100	<0.1	<10	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	110	0.13	10	0.05	0.04	0.11	0.12	0.18
Chloride	43100	1.28	37.1	<0.5	<0.5	55.4	9.36	<0.5
Fluoride	—	<0.2	20.6	<0.2	<0.2	<0.2	<0.2	<0.2
Nitrates	(7920)	2.22	67.9	1.36	1.24	<0.2	<0.2	0.24
Sulfates	—	10	299	<6	<6	24800	11400	38
				220,439 445	1024, 1025		224, 440	363, 454

Test 9-5			TABLE				Outlet of ESP	
POLLUTANT	SAMPLE NUMBER							
	364*	1021+	1022+	1023+				
Antimony	<0.1	<35	<50	<50				
Arsenic	0.04	1.6	2.5	2.0				
Barium	<0.1	<15	<20	<20				
Beryllium	<0.005	1.3	1.0	1.8				
Cadmium	0.010	1.0	5.4	4.3				
Calcium	0.05	77000	520000	280000				
Chromium	0.02	8	31	14				
Cobalt	<0.02	22	28	36				
Copper	<0.01	6	15	12				
Iron	0.05	7700	23000	11000				
Lead	<0.02	<150	<200	<200				
Manganese	<0.01	58	110	80				
Mercury	<0.005	<0.2	<0.2	<0.2				
Nickel	<0.02	16	24	24				
Selenium	<0.04	<4	<4	<4				
Tellurium	<2	<40	<50	<50				
Tin	<1	<40	<50	<50				
Titanium	<0.5	1300	2400	2000				
Vanadium	<0.1	20	70	40				
Zinc	0.03	20	22	55				
Chloride	<0.5	79.6	2.85	2140				
Fluoride	—	40.6	62.0	163				
Nitrates	<0.2	4.01	<1.4	8.22				
Sulfates	<6	28.6	<45	<45				

Test 9-5			TABLE					Outlet of ESP
POLLUTANT	SAMPLE NUMBER							
	E*	455*	F*	365*				
Antimony	<0.1	<0.1	<0.1	—				
Arsenic	<0.003	<0.003	<0.003	—				
Barium	<0.5	<0.5	<0.5	—				
Beryllium	<0.005	<0.005	<0.005	<0.005				
Cadmium	<0.01	<0.01	<0.01	—				
Calcium	110	370	840	4				
Chromium	0.10	0.25	0.45	—				
Cobalt	<0.02	0.04	0.06	—				
Copper	<0.02	0.02	0.06	—				
Iron	4.3	13	42	—				
Lead	<0.1	<0.1	<0.1	<0.1				
Manganese	0.15	0.15	0.42	—				
Mercury	<0.003	<0.003	<0.003	<0.003				
Nickel	0.07	0.15	0.30	—				
Selenium	<0.005	<0.005	<0.005	—				
Tellurium	<0.5	<0.5	<0.5	—				
Tin	<0.5	<0.5	<0.5	—				
Titanium	0.5	2.4	7.3	—				
Vanadium	<0.02	0.2	0.2	—				
Zinc	0.02	0.04	0.17	—				
Chloride	2.12	1.70	1.06	—				
Fluoride	0.84	2.00	2.60	—				
Nitrates	0.38	0.86	1.94	—				
Sulfates	<8	<8	18	—				
	400, 459		415,458					

KVB

REVISED 2/28/78

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 9-6 Date 10/5/76 Location 9 CEMENT KILN

Sample Port Position OUTLET OF ESP

** DO SSMS FIRST THEN AA BASED ON SSMS RESULTS
- SEE SSMS PLAN SHEET.

	Container Number	Sample Description	Container Type	Net wt/vol.	Comment
**	409	S P+N+10μ SOLID	4 oz N	0.0122g	DO SSMS-THEN AA
	NONE	3μ SOLIDS			
**	408	S 1μ SOLIDS	4 oz N.	0.5775g	DO SSMS-THEN AA
**	276	S #1 FILTER	PETRI	0.2042g	"
*	471	L P+N+10μ WASH	16 oz A	460ml	1468ml TOT
	467	L 3μ NORM. WASH	"	360ml	
	466	L 3μ H_2O WASH	"	329ml	
	470	L 1μ WASH	"	254ml	
	465	L FILTER HOUS. WASH	"	65ml	
	475	L XAD MOD RINSE	"	417ml	
	295	S XAD RESINE	16 oz AWM	161g	440-279
K*	449	L XAD CONDENS.	16 oz A	406ml	2863ml TOT.
	450	L "	"	397ml	
	451	L "	"	410ml	
	452	L "	"	449ml	
	453	L "	"	407ml	
	456	L "	"	412ml	
	457	L "	"	382ml	
	1027	L IMPINGER #1	1 gal GLASS	3764ml	3340-424 RINSE (1500 ORIG)
L*	500	L IMPINGER #2 (1)	1l N	292ml	1105-805-300 RINSE
	525	L " (2)	1l N	813ml	
	362	L IMPINGER #3 (1)	8 oz A	214ml	941-715 = 226 RINSE
	529	L " (2)	1l N	727ml	
	368	L H_2O RINSE 2&3	8 oz A	121ml	174
	370	L "	8 oz A	53ml	
	360	LB Imp#1 BLANK	"	120ml	
	367	LB H_2O BLANK	"	118ml	
	361	LB CH_2Cl_2 : CH_3OH BLK.	"	76ml	

Data Sheet KVB 6002-15

KVB

Pg 2

TRACE SPECIES AND ORGANICS TEST
SAMPLE RECOVERY LOG

Test No. 9-6 Date 10/5/76 Location 9 Cement Kiln

Sample Port Position Outlet Of ESP

Container Number	Sample Description	Container Type	Net wt/vol.	Comment
366	LB Imp 2,3 Blk	Box A	122ml	
1028	P Cement Feed Slurry	Glass	1116g	
1029	P Cement Clinker	"	741.6g	
1030	P ESP Catch	"	490.7g	
Count	S-4 Train Solids			
	L-5 Train Liquids			
	LB-4 Liquid Blanks			
	P-3 Process Solids			
	16 Analyses			
	31 Bottles			

Data Sheet KVB 6002-15

Test 9-6				TABLE			Outlet of ESP	
POLLUTANT	SAMPLE NUMBER							
	276+	475*	295+	K*	1027*	L*	360*	367*
Antimony	<500	<0.1	<50	0.2	0.2	1.6	0.4	0.3
Arsenic	10	<0.02	<0.5	<0.02	<0.02	<0.02	0.03	<0.02
Barium	<20	0.50	<20	<0.1	<0.1	0.20	<0.1	0.20
Beryllium	16	<0.005	<0.5	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	16	0.015	<1	<0.01	<0.01	0.030	<0.01	<0.01
Calcium	440000	1.0	38000	1.4	1.7	0.36	1.2	1.3
Chromium	240	0.03	1	0.03	0.04	0.19	0.08	0.02
Cobalt	230	<0.02	<3	0.02	0.02	0.16	0.02	0.03
Copper	70	0.06	1	0.02	0.02	0.02	<0.01	<0.01
Iron	17000	0.47	100	0.08	0.17	0.74	0.08	0.22
Lead	<2000	0.05	<200	<0.02	0.03	0.10	<0.02	0.02
Manganese	320	0.025	<2	0.015	0.020	0.050	0.010	0.010
Mercury	<2	<0.005	<2	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	140	0.04	<3	0.04	0.04	0.16	0.02	0.02
Selenium	<4	<0.04	<4	<0.04	<0.04	<0.04	<0.04	<0.04
Tellurium	<500	<2	<50	<2	<2	<2	<2	<2
Tin	<500	<1	<50	<1	<1	<1	<1	<1
Titanium	4000	<0.5	<100	<0.5	<0.5	<0.5	<0.5	0.5
Vanadium	100	<0.1	<10	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	230	0.06	<1	0.05	0.06	0.09	0.05	0.05
Chloride	60700	4.68	19.1	1.28	0.42	70.2	<0.5	<0.5
Fluoride	—	<0.4	30.4	<0.2	<0.2	<0.2	—	—
Nitrates	(5850)	1.00	46.4	0.44	0.98	<0.2	1.64	0.64
Sulfates	—	<6	<58	<6	<6	26400	<6	<6
				449,450 451,452 453,456 457		500,525 362,529 368,370		

Test 9-6			TABLE		Outlet of ESP			
POLLUTANT	SAMPLE NUMBER							
	361*	366*	1028+	1029+	1030+			
Antimony	0.2	1.7	<22	<50	<50			
Arsenic	0.04	<0.02	1.8	2.0	2.5			
Barium	0.15	<0.1	<10	<20	<20			
Beryllium	<0.005	<0.005	0.5	0.9	0.9			
Cadmium	0.01	0.03	0.5	3.0	3.8			
Calcium	1.0	1.5	130000	250	210			
Chromium	0.10	0.05	7	22	23			
Cobalt	<0.02	0.10	10	25	23			
Copper	0.02	0.04	5	12	9			
Iron	0.17	2.1	9500	23000	11000			
Lead	0.02	0.24	<90	<200	<200			
Manganese	<0.01	0.030	50	140	72			
Mercury	<0.005	<0.005	<0.1	<0.2	<0.2			
Nickel	0.02	0.10	12	22	20			
Selenium	<0.04	<0.04	<4	<4	<4			
Tellurium	<2	<2	<25	<50	<50			
Tin	<1	<1	<25	<50	<50			
Titanium	0.5	0.5	1100	2300	2100			
Vanadium	<0.1	<0.1	26	60	45			
Zinc	0.07	0.18	10	42	41			
Chloride	1.06	81.8	72.1	15.8	3550			
Fluoride	—	—	46.5	74.5	181			
Nitrates	<0.2	<0.2	<1.4	<1.2	7.74			
Sulfates	<6	47600	41.9	34.1	52.8			

Test 9-6		TABLE						Outlet of ESP
POLLUTANT	SAMPLE NUMBER							
	409+	408+						
Antimony	-- all of samples to CTE --	<26						
Arsenic		0.65						
Barium		<65						
Beryllium		<0.7						
Cadmium		<1.3						
Calcium		260000						
Chromium		100						
Cobalt		26.0						
Copper		21.0						
Iron		8800						
Lead		<13						
Manganese		100						
Mercury		<0.02						
Nickel		65						
Selenium		<0.5						
Tellurium		<65						
Tin		<65						
Titanium		3600						
Vanadium		81						
Zinc		36						
Chloride		—						
Fluoride		—						
Nitrates		—						
Sulfates		—						

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 999 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-9434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9321

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 12, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 276 Test 9-6

IAD No.: 97-A165-134-03

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	2	Terbium	0.2	Ruthenium		Vanadium	28
Thorium	4	Gadolinium	0.7	Molybdenum	14	Titanium	730
Bismuth		Europium	0.4	Niobium	6	Scandium	2
Lead	7	Samarium	2	Zirconium	36	Calcium	MC
Thallium	≤1	Neodymium	3	Yttrium	4	Potassium	MC
Mercury	NR	Praseodymium	3	Strontium	90	Chlorine	MC
Gold		Cerium	16	Rubidium	MC	Sulfur	MC
Platinum		Lanthanum	13	Bromine	54	Phosphorus	970
Iridium		Barium	130	Selenium	3	Silicon	MC
Osmium		Cesium	100	Arsenic	47	Aluminum	MC
Rhenium		Iodine	13	Germanium	6	Magnesium	MC
Tungsten		Tellurium		Gallium	7	Sodium	240
Tantalum		Antimony	≤0.5	Zinc	37	Fluorine	≈400
Hafnium		Tin	≤0.6	Copper	8	Oxygen	NR
Lutetium		Indium	STD	Nickel	12	Nitrogen	NR
Ytterbium		Cadmium	≤0.5	Cobalt	5	Carbon	NR
Thulium		Silver	0.5	Iron	MC	Boron	59
Erbium		Palladium		Manganese	32	Beryllium	0.2
Holmium		Rhodium		Chromium	210	Lithium	26
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.2 ppm weight

Approved: M Y Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-9494
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 12, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 408 Test 9-6

IAD No.: 97-A165-134-03

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	5	Terbium	0.5	Ruthenium		Vanadium	160
Thorium	9	Gadolinium	2	Molybdenum	6	Titanium	MC
Bismuth		Europium	0.8	Niobium	7	Scandium	8
Lead	8	Samarium	4	Zirconium	69	Calcium	MC
Thallium		Neodymium	8	Yttrium	8	Potassium	MC
Mercury	NR	Praseodymium	6	Strontium	170	Chlorine	MC
Gold		Cerium	21	Rubidium	310	Sulfur	MC
Platinum		Lanthanum	22	Bromine	100	Phosphorus	MC
Iridium		Barium	110	Selenium	3	Silicon	MC
Osmium		Cesium	16	Arsenic	28	Aluminum	MC
Rhenium		Iodine	25	Germanium	1	Magnesium	MC
Tungsten		Tellurium		Gallium	14	Sodium	MC
Tantalum		Antimony	$\leq$0.9	Zinc	35	Fluorine	MC
Hafnium		Tin	2	Copper	14	Oxygen	NR
Lutetium		Indium	STD	Nickel	88	Nitrogen	NR
Ytterbium		Cadmium	$\leq$0.9	Cobalt	13	Carbon	NR
Thulium		Silver	1	Iron	MC	Boron	20
Erbium		Palladium		Manganese	230	Beryllium	0.9
Holmium		Rhodium		Chromium	130	Lithium	17
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.5 ppm weight

Approved: M Y Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 919 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-0424
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14035 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9321

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: April 12, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 409 Test 9-6

IAD No.: 97-A165-134-03

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤4	Terbium	0.4	Ruthenium		Vanadium	44
Thorium	≤5	Gadolinium	1	Molybdenum	4	Titanium	MC
Bismuth		Europium	0.6	Niobium	4	Scandium	5
Lead	26	Samarium	2	Zirconium	37	Calcium	MC
Thallium	2	Neodymium	5	Yttrium	6	Potassium	MC
Mercury	NR	Praseodymium	5	Strontium	150	Chlorine	MC
Gold		Cerium	20	Rubidium	830	Sulfur	MC
Platinum		Lanthanum	18	Bromine	83	Phosphorus	MC
Iridium		Barium	120	Selenium	2	Silicon	MC
Osmium		Cesium	26	Arsenic	20	Aluminum	MC
Rhenium		Iodine	9	Germanium	2	Magnesium	MC
Tungsten		Tellurium		Gallium	6	Sodium	MC
Tantalum		Antimony	≤0.8	Zinc	63	Fluorine	MC
Hafnium		Tin	≤0.9	Copper	15	Oxygen	NR
Lutetium		Indium	STD	Nickel	14	Nitrogen	NR
Ytterbium		Cadmium	≤0.7	Cobalt	3	Carbon	NR
Thulium		Silver	≤0.5	Iron	MC	Boron	8
Erbium		Palladium		Manganese	490	Beryllium	0.5
Holmium		Rhodium		Chromium	66	Lithium	41
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.4 ppm weight

Approved: M Y Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 999 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 738-0424
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14585 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-1021

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-6 A #471, 467, 466, 470, 465

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.03
Thorium		Gadolinium		Molybdenum	0.04	Titanium	0.4
Bismuth		Europium		Niobium		Scandium	≤0.002
Lead	≤0.06	Samarium		Zirconium	≤0.02	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.02	Chlorine	3
Gold		Cerium		Rubidium	0.03	Sulfur	0.2
Platinum		Lanthanum		Bromine	0.04	Phosphorus	0.5
Iridium		Barium	0.05	Selenium		Silicon	MC
Osmium		Cesium	≤0.006	Arsenic	≤0.007	Aluminum	5
Rhenium		Iodine	≤0.02	Germanium		Magnesium	1
Tungsten	≤0.08	Tellurium		Gallium	≤0.01	Sodium	4
Tantalum		Antimony		Zinc	0.4	Fluorine	≈1
Hafnium		Tin	≤0.03	Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.005
Erbium		Palladium		Manganese	0.03	Beryllium	
Holmium		Rhodium		Chromium	0.08	Lithium	0.009
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.01 µg/ml

Approved: M. Sparks

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14235 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-6 B #295

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤4	Terbium		Ruthenium		Vanadium	0.4
Thorium	≤4	Gadolinium		Molybdenum	3	Titanium	≤13
Bismuth		Europium		Niobium		Scandium	≤0.3
Lead	≤2	Samarium		Zirconium	≤0.8	Calcium	260
Thallium		Neodymium		Yttrium		Potassium	80
Mercury	NR	Praseodymium		Strontium	0.5	Chlorine	14
Gold		Cerium		Rubidium	0.2	Sulfur	7
Platinum		Lanthanum		Bromine	2	Phosphorus	64
Iridium		Barium	2	Selenium	≤1	Silicon	MC
Osmium		Cesium	≤0.2	Arsenic	≤0.4	Aluminum	110
Rhenium		Iodine	≤0.7	Germanium		Magnesium	*110
Tungsten		Tellurium		Gallium	≤0.4	Sodium	140
Tantalum		Antimony	≤1	Zinc	2	Fluorine	≈9
Hafnium		Tin	1	Copper	2	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.4	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.1	Carbon	NR
Thulium		Silver		Iron	14	Boron	1
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	6	Lithium	0.2
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.5ppm weight
*Heterogeneous Sample was thermally ashed @ 350° C for one hour in a laboratory furnace in a quartz crucible prior to analysis.

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 630 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 738-0424
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14330 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9121

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-6 C #449, 460, 451, 452, 453, 456, 457, 1027, 500, 525, 362, 529, 368, 370

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.04	Terbium		Ruthenium		Vanadium	0.02
Thorium	≤0.04	Gadolinium		Molybdenum	0.02	Titanium	≤0.1
Bismuth		Europium		Niobium	≤0.006	Scandium	≤0.005
Lead	0.02	Samarium		Zirconium	≤0.007	Calcium	5
Thallium		Neodymium		Yttrium		Potassium	1
Mercury	NR	Praseodymium	≤0.02	Strontium	0.02	Chlorine	0.2
Gold		Cerium	0.009	Rubidium	0.009	Sulfur	MC
Platinum		Lanthanum	≤0.03	Bromine	0.2	Phosphorus	2
Iridium		Barium	0.1	Selenium	≤0.1	Silicon	1
Osmium		Cesium	0.002	Arsenic	≤0.002	Aluminum	0.2
Rhenium		Iodine	0.4	Germanium		Magnesium	0.5
Tungsten		Tellurium		Gallium	0.01	Sodium	MC
Tantalum		Antimony	0.1	Zinc	0.2	Fluorine	≈0.4
Hafnium		Tin	≤0.01	Copper	0.06	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.008	Carbon	NR
Thulium		Silver	MC	Iron	0.4	Boron	0.004
Erbium		Palladium		Manganese	0.02	Beryllium	
Holmium		Rhodium		Chromium	0.05	Lithium	0.004
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.004 µg/ml

Approved: M S Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 233 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-0434
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14205 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9621

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810
Sample No.: 9-6 D #360

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤0.07	Terbium		Ruthenium		Vanadium	0.003
Thorium	≤0.08	Gadolinium		Molybdenum	*0.05	Titanium	≤0.2
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	0.06	Samarium		Zirconium	0.02	Calcium	8
Thallium		Neodymium		Yttrium		Potassium	1
Mercury	NR	Praseodymium		Strontium	0.02	Chlorine	0.6
Gold		Cerium	0.02	Rubidium	≤0.002	Sulfur	0.6
Platinum		Lanthanum	0.02	Bromine	0.03	Phosphorus	4
Iridium		Barium	0.2	Selenium	≤0.03	Silicon	3
Osmium		Cesium		Arsenic	≤0.005	Aluminum	0.3
Rhenium		Iodine	0.01	Germanium		Magnesium	2
Tungsten	≤0.05	Tellurium		Gallium	≤0.007	Sodium	MC
Tantalum		Antimony	≤0.02	Zinc	0.07	Fluorine	≈7
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium	≤0.02	Cobalt	≤0.003	Carbon	NR
Thulium		Silver	0.04	Iron	0.2	Boron	0.02
Erbium		Palladium		Manganese	0.005	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	0.006
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.01 µg/ml
*Heterogeneous

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 630 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14000 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-6021

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 9, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-6 E #367

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum	0.06	Titanium	0.06
Bismuth		Europium		Niobium		Scandium	≤0.002
Lead	≤0.07	Samarium		Zirconium	0.02	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	0.7
Mercury	NR	Praseodymium		Strontium	0.02	Chlorine	0.3
Gold		Cerium	0.02	Rubidium	0.003	Sulfur	0.4
Platinum		Lanthanum	0.03	Bromine	0.02	Phosphorus	0.5
Iridium		Barium	0.1	Selenium	≤0.02	Silicon	1
Osmium		Cesium	0.004	Arsenic	0.01	Aluminum	0.1
Rhenium		Iodine	0.02	Germanium		Magnesium	0.5
Tungsten	≤0.06	Tellurium		Gallium	≤0.009	Sodium	MC
Tantalum		Antimony		Zinc	0.03	Fluorine	≈0.4
Hafnium		Tin	≤0.02	Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	*0.08	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver	≤0.01	Iron	0.5	Boron	0.01
Erbium		Palladium		Manganese	0.01	Beryllium	<0.001
Holmium		Rhodium		Chromium	*0.06	Lithium	0.01
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.01 µg/ml
*Heterogeneous

Approved:

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 630 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-6464
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14355 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9221

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-6 F #361

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	≤0.003
Thorium		Gadolinium		Molybdenum	≤0.06	Titanium	≤0.4
Bismuth		Europium		Niobium		Scandium	≤0.002
Lead	≤0.07	Samarium		Zirconium		Calcium	4
Thallium		Neodymium		Yttrium		Potassium	0.2
Mercury	NR	Praseodymium		Strontium	0.01	Chlorine	0.6
Gold		Cerium		Rubidium	≤0.003	Sulfur	0.2
Platinum		Lanthanum		Bromine	0.04	Phosphorus	0.3
Iridium		Barium	≤0.04	Selenium	≤0.04	Silicon	0.2
Osmium		Cesium		Arsenic	≤0.008	Aluminum	0.04
Rhenium		Iodine	≤0.02	Germanium		Magnesium	0.3
Tungsten		Tellurium		Gallium	≤0.01	Sodium	5
Tantalum		Antimony		Zinc	0.04	Fluorine	≈0.6
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.003	Carbon	NR
Thulium		Silver		Iron	0.09	Boron	0.005
Erbium		Palladium		Manganese	0.003	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	0.005
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.01 µg/ml

Approved: M Jacobs

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 630 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14036 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-6521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-6 G #366

IAD No.: 97-A101-134-21

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.008
Thorium		Gadolinium		Molybdenum	≤0.1	Titanium	≤0.1
Bismuth		Europium		Niobium		Scandium	≤0.006
Lead	≤0.2	Samarium		Zirconium	0.08	Calcium	7
Thallium		Neodymium		Yttrium	0.03	Potassium	MC
Mercury	NR	Praseodymium		Strontium	0.06	Chlorine	0.3
Gold		Cerium		Rubidium	0.02	Sulfur	MC
Platinum		Lanthanum		Bromine	≤0.8	Phosphorus	0.2
Iridium		Barium	0.2	Selenium	≤0.3	Silicon	MC
Osmium		Cesium		Arsenic	0.1	Aluminum	0.02
Rhenium		Iodine	≤0.5	Germanium	0.07	Magnesium	2
Tungsten		Tellurium		Gallium	0.2	Sodium	MC
Tantalum		Antimony	0.2	Zinc	≤0.06	Fluorine	MC
Hafnium		Tin	0.1	Copper	0.07	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium	≤0.07	Cobalt	≤0.007	Carbon	NR
Thulium		Silver	MC	Iron	0.7	Boron	0.09
Erbium		Palladium		Manganese	0.05	Beryllium	0.002
Holmium		Rhodium		Chromium	0.1	Lithium	0.005
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported < 0.04 µg/ml

Approved:

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 630 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8484

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14500 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-5511

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 9, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-6 H KVB #1028

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	6	Terbium	0.2	Ruthenium		Vanadium	20
Thorium	3	Gadolinium	1	Molybdenum	2	Titanium	590
Bismuth	≤0.4	Europium	0.5	Niobium	5	Scandium	0.9
Lead	8	Samarium	4	Zirconium	32	Calcium	MC
Thallium		Neodymium	5	Yttrium	7	Potassium	MC
Mercury	NR	Praseodymium	3	Strontium	140	Chlorine	45
Gold		Cerium	26	Rubidium	14	Sulfur	14
Platinum		Lanthanum	21	Bromine	1	Phosphorus	340
Iridium		Barium	86	Selenium	0.8	Silicon	MC
Osmium		Cesium	3	Arsenic	10	Aluminum	MC
Rhenium		Iodine	4	Germanium	0.5	Magnesium	MC
Tungsten	≤1	Tellurium		Gallium	5	Sodium	MC
Tantalum		Antimony	≤0.4	Zinc	13	Fluorine	≈280
Hafnium		Tin	0.5	Copper	5	Oxygen	NR.
Lutetium		Indium	STD	Nickel	7	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	3	Carbon	NR
Thulium		Silver		Iron	MC	Boron	5
Erbium	0.5	Palladium		Manganese	68	Beryllium	0.1
Holmium	0.5	Rhodium		Chromium	18	Lithium	6
Dysprosium	1					Hydrogen	NR

NR – Not Reported
All elements not reported <0.2 ppm weight

Approved: M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 230 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-0424

Reply to INSTRUMENTAL ANALYSIS DIVISION, 14200 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9821

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 11, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: g-6 I #1029

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	≤4	Terbium	0.7	Ruthenium		Vanadium	30
Thorium	≤5	Gadolinium	2	Molybdenum	≤3	Titanium	MC
Bismuth	≤0.9	Europium	1	Niobium	3	Scandium	6
Lead	4	Samarium	7	Zirconium	73	Calcium	MC
Thallium	≤1	Neodymium	6	Yttrium	7	Potassium	MC
Mercury	NR	Praseodymium	3	Strontium	180	Chlorine	60
Gold		Cerium	20	Rubidium	9	Sulfur	35
Platinum		Lanthanum	23	Bromine	≤2	Phosphorus	MC
Iridium		Barium	220	Selenium	2	Silicon	MC
Osmium		Cesium	≤0.3	Arsenic	8	Aluminum	MC
Rhenium		Iodine	0.6	Germanium		Magnesium	MC
Tungsten		Tellurium		Gallium	6	Sodium	MC
Tantalum		Antimony	≤0.9	Zinc	27	Fluorine	MC
Hafnium		Tin	≤1	Copper	5	Oxygen	NR
Lutetium		Indium	STD	Nickel	14	Nitrogen	NR
Ytterbium		Cadmium	0.8	Cobalt	9	Carbon	NR
Thulium		Silver		Iron	MC	Boron	16
Erbium	0.9	Palladium		Manganese	100	Beryllium	0.6
Holmium	2	Rhodium		Chromium	45	Lithium	50
Dysprosium	2\					Hydrogen	NR

NR – Not Reported
All elements not reported <0.2ppm weight

Approved: M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 920 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8484
Reply to INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST 44TH AVENUE, GOLDEN, COLORADO 80401, PHONE: 303-279-9521

To: Mr. John G. Michalovic
Calspan Corporation
Post Office Box 235
Buffalo, NY 14221

Date: March 9, 1977

Analyst: S. Sweeney

P. O. No.: 27810

Sample No.: 9-6 J #1030

IAD No.: 97-A101-134-21

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	3	Terbium	0.2	Ruthenium		Vanadium	33
Thorium	5	Gadolinium	0.7	Molybdenum	5	Titanium	MC
Bismuth	<0.3	Europium	0.3	Niobium	6	Scandium	3
Lead	64	Samarium	2	Zirconium	46	Calcium	MC
Thallium	5	Neodymium	5	Yttrium	6	Potassium	MC
Mercury	NR	Praseodymium	4	Strontium	230	Chlorine	MC
Gold		Cerium	26	Rubidium	300	Sulfur	MC
Platinum		Lanthanum	48	Bromine	34	Phosphorus	760
Iridium		Barium	190	Selenium	2	Silicon	MC
Osmium		Cesium	26	Arsenic	25	Aluminum	MC
Rhenium		Iodine	21	Germanium	0.4	Magnesium	MC
Tungsten		Tellurium		Gallium	6	Sodium	MC
Tantalum		Antimony	0.6	Zinc	39	Fluorine	=620
Hafnium		Tin	0.7	Copper	6	Oxygen	NR
Lutetium		Indium	STD	Nickel	7	Nitrogen	NR
Ytterbium		Cadmium	0.3	Cobalt	3	Carbon	NR
Thulium		Silver	0.3	Iron	MC	Boron	7
Erbium		Palladium		Manganese	180	Beryllium	0.2
Holmium		Rhodium		Chromium	27	Lithium	55
Dysprosium						Hydrogen	NR

NR – Not Reported
All elements not reported <0.2 ppm weight

Approved: M Sparks